INTEGRATED EDITION OF THE PETROLEUM ENGINEER

the Petroleum Engineer

FOR MANAGEMENT

APRIL 1958

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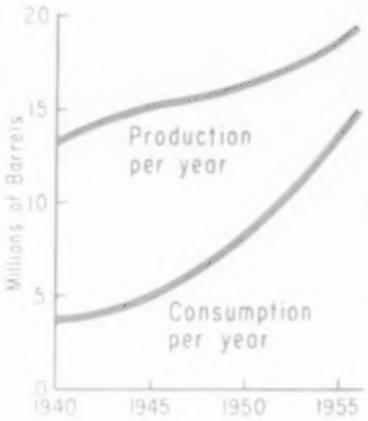


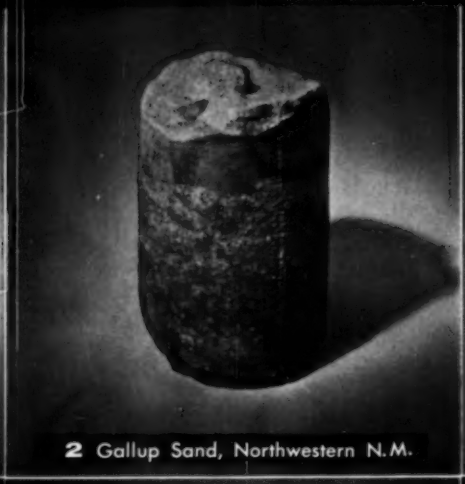
"Senor Petroleo"... A-8

Gas Lift for Stripper Wells
SEE PAGE B-77

Geology of Eastern Peru Today
SEE PAGE B-32

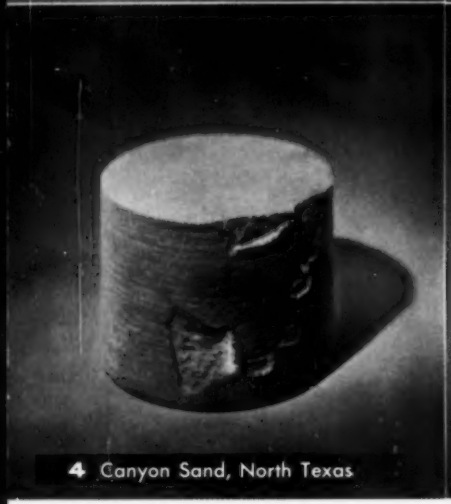
Connole Views Gas Imports
SEE PAGE D-50

1 Clear Fork Lime, West Texas



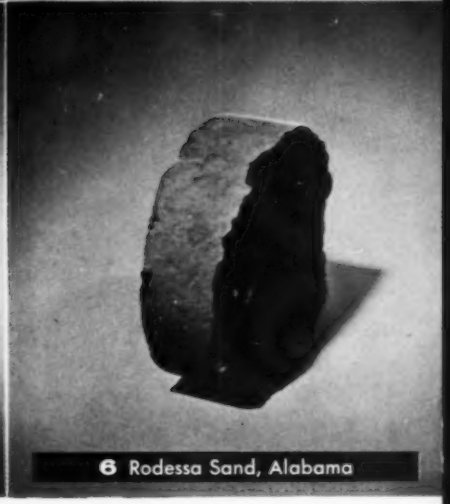
2 Gallup Sand, Northwestern N.M.

3 Triassic "D", British Columbia



4 Canyon Sand, North Texas

5 Wilcox Sand, South Texas



6 Rodessa Sand, Alabama

Dowell Guide To Fracturing

1 Clear Fork Lime, West Texas: This limestone contains varying amounts of dolomite and salt. Duofrac* has been quite successful — using large volumes of weak acid as a sand carrier. This fluid attacks both the formation and salt crystals. 50,000-gallon treatments, injection rates up to 50 bpm and ball sealers, are common. After treatment, some wells potential over 300 bopd.

2 Gallup Sand, Northwestern New Mexico: This core is from one of the better Bisti wells. Permeability is often less than one millidarcy and porosity ranges from zero to 12 per cent. Before treatment, wells often will not produce commercially. After a 500-gallon spearhead of Mud Acid, followed by Sandfrac* — using 50,000 gallons of lease crude and 50,000 pounds of sand at 30 to 40 bpm — many wells potential up to 600 bopd.

3 Triassic "D", British Columbia: This sandstone gas pay frequently produces commercially before fracturing. However, many operators have increased potentials by fracturing with Sandfrac*, using diesel oil with 100 pounds of FLA (Fluid Loss Agent) per 1,000 gallons. Treatments usually consist of 20,000 gallons fluid and 20,000 pounds sand down tubing at about 8 bpm. Results vary widely — with increases from two to 25 mmcfd being reported.

4 Canyon Sand, North Texas: Wells completed in this Pennsylvanian age formation often give high initial production (80 to 300 bopd). However, a steep decline curve to 8 or 10 bopd in six to nine months makes fracturing advisable. Usual treatment is a spearhead of 500 to 1,000 gallons of a special acid followed by Sandfrac* — using 10,000 to 20,000 gallons lease crude and 1½ pounds sand per gallon. FLA* (Fluid Loss Additive) is often used. Treatment generally increases production and reduces decline rate.

5 Wilcox Sand, South Texas: This shale-streaked sandstone is found from 8,000 to 11,000 feet. Bottom-hole temperature is high — from 225° to 300°F — and pay zones range from 15 to 200 feet in thickness. Stratafrac* is often used because it is designed to clean up fast and suspends sand well at high temperatures. Treatments range from 6,000 to 12,000 gallons injected at 3 to 5 bpm, with 1 pound of sand per gallon. Production frequently increases from less than 10 to 70 bopd through choke.

6 Rodessa Sand, Alabama: The Citronelle Field produces from two sections of dirty sand varying in depth from 10,400 to 11,600 feet. Super Mud Acid, with an added silicate control agent, is used to dissolve and shrink clays. Petrojel*, using 20,000 to 30,000 gallons jelled crude with 20,000 to 40,000 pounds sand is usually recommended. Ball sealers are frequently used to spread the effect of the treatment. Many wells then potential over 300 bopd.

With nine basic fracturing treatments and many variations of each, Dowell engineers can help you "tailor" treatments to the requirements of your job. Results have shown quick payouts, slow decline rates, few workovers, and excellent ultimate recoveries. Dowell Incorporated, Tulsa 1, Oklahoma.

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FOR MANAGEMENT

NUMBER 4 • VOLUME XXX • APRIL, 1958

The Conference Table A-10

Where there is no free agency, there can be no morality . . .
— *Prescott*

Peru Trades Opportunity for Capital A-19

The legendary land of the Incas is advancing so rapidly into the modern world that oil consumption is overtaking production. Privately owned companies get a fair deal from the government in this third largest oil producing nation in South America.
— *An interview with Fernando Saravia Martin*

Peru Prepares for Future A-22

Oil companies hold concessions over some 33 million acres — more than any other Latin American nation. Consumption will soon overtake production if more reserves are not found. Explorers have great hopes for new producing areas in the jungles of the Oriente. — *Ernestine Adams*

Are You Phonogenic? A-28

Get a line on yourself.

You Can Study Petroleum Engineering Abroad A-30

Not only has U. S. education developed and expanded in this field . . . Foreign universities have established technological courses for future oil men. — *Harry H. Power*

Wanted: Retired Executive Specialists A-31

If you are retired, here's a job opportunity. If you need expert help, here's a place to find it.

Peru's Petroleum Laws Invite Private Capital A-32

Terms favor operations in Eastern Zone where concessions are granted for longer periods and cost less.

E SECTION FOLLOWS A

Management Problems for Executives E-17

Given twice a year for an 8-week period, program has had nearly a 1000 attendance in its 18 years at the University of Pittsburgh. — *C. L. Van Sickle*

Fight Fat and Fatigue E-18

Noted medical research director tells you how to handle your health. You can prevent heart disease by following two rules.
— *Louis N. Katz*

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DRILLING AND PRODUCING

Exploration Problems in Peru B-21
Carlos del Solar B.
Geologists Fete Award Winners at AAPG Meeting B-25
Geological Features of Peru B-26
Dr. J. E. Rassmuss
Petroleum Geology of Eastern Peru — Today B-32
Dr. Werner Ruegg
Successful Southern District API Meet B-44
A Fundamental Approach to Well Bore Stabilization B-45
W. J. Weiss, R. H. Graves, and W. L. Hall
Drilling in Marañon Basin of Peru B-62
Andrew H. Allbee and Samuel T. Pees
Producing Stripper Wells by Gas Lift in Peru B-77
H. W. Winkler
Oil Future of the Oriente Zone: Exploration to End Use B-94
L. J. Herrera, Jr.
Sea Water Flood in Peru B-102
W. E. Harris and H. B. Zaremba
Peru's Production Edges Up B-110
C. N. Griffis
Simplified Gamma-Ray Technique Used in LPG-Storage Well Logging B-118
Robert F. Sippel and H. Darwin Hodges
Paris Basin of Central France Scene of Major Oil Discovery B-129
Joseph A. Kornfeld
Southwestern District API Talks Air Power and Oil B-146
World Depth Record Contender Drilling Ahead B-151

REFINING AND PETROCHEMICAL

Curves for Rapid Estimation of Gasoline Plant Investment C-7
B. T. Brady and R. L. Rorschach
Role of the Project Engineer in Plant Design and Construction C-9
Howard F. Rase
Scheduling Engineering Design C-11
H. T. Campbell
NGAA Sets Technical Program for 37th Annual Meeting C-13
Developing Equipment Specifications C-14
Dr. Charles H. Brooks
Use Digital Computers as Distillation Column Design Aid C-15
Robert N. Maddox
The Refining Engineer's Buyers' Guide C-19
Contents C-20
Functional Directory of Products C-21
Company Directory C-49
Supplementary Listings C-113

OIL AND GAS PIPELINING

What is Economic Pipe Size? D-19
C. J. Shelton, Jr.
Proper Lubrication = Longer Compressor Life D-26
H. P. Henderson

CORROSION FEATURE

Guide to Selection of Coal Tar Coatings — Part 2 . . . . . D-29
N. T. Shideler
What the Canadian Contractors Talked About D-32
Leslie Orr Rowland

PIPELINE FUNDAMENTALS

Pipeline Welding — Part 1 . . . . . D-35
Richard D. Morel

DEVELOPMENTS TO WATCH

Electricity Directly from Gas? D-42
Chemical Film Reduces Water Evaporation D-44
The Gas Turbine as a Turbocharger D-46
Rudolph Birmann
What Are the Prospects of Canadian Gas for U. S.? D-50
William R. Connole
Canadian News Notes D-53

FEATURES

The Course of Oil A-4
Advertisers' Index A-6
Petroleum Profile A-8
Douglas Fyfe
Highlights A-12
Meetings A-14
The Trade Parade E-19
Management Personals E-30
A Guide to Books E-33
Laugh with Barney E-39
Of Things to Come in Oil B-3
The Oasis B-132
Exploration Activities B-135
What's Doing in Drilling B-148
Running Tour with Men in the Industry B-152
New Equipment B-155
New Literature B-157
New Refining Projects C-3
New Equipment C-114
New Literature C-119
Refining and Petrochemical Personals . . C-121
Pipeline Developments D-3
Pipeline Personals D-55
Pipeline Projects D-57
Pipeline News D-61
With the Pipeline Contractors D-62
New Equipment D-64
New Literature D-65

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Fabled Land of Peru

Three U. S. businessmen fishing near Lake Titicaca, in southeast Peru, one day last year were attacked by Indians. They accused the North Americans of sending food to drought-stricken southern Peru to feed the Indians before slaughtering them for their fat.

On the same afternoon elegantly dressed dowagers and debutantes and their escorts enjoyed high tea at Lima's Hotel Bolivar, a tradition of a society that is one of the most formal and exclusive in the world.

These are two contrasting incidents that set the scene of Peru. You can find almost anything you look for in this fabled land. Archaeologists are thrilled by the ancient cities and roads of the great Inca empire that are among the wonders of the world. Educators visit San Marcos in Lima, the oldest university in the Western Hemisphere, founded 85 years before Harvard.

Some tourists will tell you that Lima, City of Kings, is the fairest city in the world. In the Andes you can find mountains higher than any outside the Himalayas and Lake Titicaca, where the fishing party was interrupted, is the highest navigable lake in the world — two and a half miles above sea level where you can sail a boat in the clouds.

Oil men find equitable petroleum laws, a reasonably stable government, a free enterprise economic system, a cultured and courteous people. Explorers are attracted by an immense jungle-covered basin, larger than Texas, that could hold great oil and gas reservoirs. Only two fields have been found — a hundred miles apart — but the potential could in time overwhelm the jaguar in his lair and still the voice of the macaws in untouched primeval forests.

Peruvians hope that new oil production will gain faster than the rise in consumption and they are willing to offer advantages to those who will venture into the Montañas of the East. Recently the margin between output and demand narrowed. In the last 10 years consumption tripled; during the same period production rose only 30 percent.

Right now national demand is filled and some crude and products are exported, mainly to neighboring states. Peru is one of three South American nations that have enough oil for their own needs.

Peru belongs in areas of fantastic promise — promise not only of greater supply but assurance of growth in demand. It is a nation that stands poised for what could be breathtaking progress.

Ernestine Adams.

Congrats and $25 to S. G. McNatt, General Delivery, Bowman, North Dakota, for this quip.

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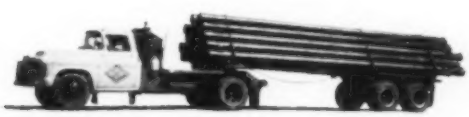

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FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

ADVERTISERS' INDEX

A

Aero Service Corporation B-90
Ajax Iron Works B-160
Aldrich Pump Company B-13
Allis-Chalmers, Engine- Material Handling Division B-14, B-15, B-37, D-16, D-17
Alten Foundry & Machine Works, Inc. B-92
American Meter Company E-33
American Petroleum Institute E-9
Annin Company, The C-40
Appleton Electric Co. D-49
Armour Chemical Division, Armour and Company B-18, B-19
Axelson Manufacturing Company B-86, B-87

B

B and W, Inc. B-116
Babcock & Wilcox Company, Tubular Products Division C-66
Baker Oil Tools, Inc. B-20, B-42, B-43
Baroid Division, National Lead Co. B-6
J. B. Beaird Company E-31
Bethlehem Steel, Shipbuilding Division B-97
Bethlehem Supply Co. E-30
Betz Laboratories, Inc. E-24
Blaw-Knox Company, Chemical Plants Division C-1
Born Engineering Co. C-69
Bradford Motor Works B-134
Brakesol, Inc. E-38
Brewster Company B-11, B-12
Brown Oil Tools, Inc. B-57
Bucyrus-Erie B-59, D-2

C

Cable Engineering B-157
Cardwell Manufacturing Company B-16, B-17
Catalytic Construction Company C-61
Catawissa Valve & Fittings Company E-34
Caterpillar Tractor Co. E-5
Chicago Bridge & Iron Company E-1-b
Chicago Steel Tank Company C-117
Christensen Diamond Products B-89
Clark Bros. Co. B-66, B-67
Classified Advertising E-37
Clayton Mark & Company E-20
Colorado Fuel and Iron Corporation, Wickwire Spencer Rope Division B-144
Consolidated Electrodynamics, Analytical & Control Instrument Division E-2
Continental-Emsco Company B-10
Continental Oil Company B-76
Cooper-Bessemer Corporation C-47
Crane Valves & Fittings D-43
M. J. Crose Manufacturing Co., Inc. D-48
Crutcher-Rolfs-Cummings, Inc. D-63
Curtiss-Wright Corporation, Utica Division E-16

D

Darling Valve & Manufacturing Co. D-45
Davison Chemical Company, Division of W. R. Grace & Co. C-2
Dearborn Chemical Company D-5
De Laval Steam Turbine Company D-12, D-13
Diamond Chain Company, Inc. B-133
Dodge Manufacturing Corporation D-55
Dorr-Oliver, Incorporated B-140
Dowell Incorporated ..... A-15, Inside Front Cover
Dresser Industries, Inc. E-6, E-7
Drilling and Exploration Company of Delaware, Inc. B-146
Drilling & Service, Inc. B-85
Allen B. DuMont Laboratories, Inc. E-24
DuPont, E. I., de Nemours & Co., Inc. C-35, C-36
Duriron Company, Inc., The D-6

E

Edward Valves, Inc. B-153
Engelhard Industries, Inc. C-6
Electro-Motive Division, General Motors B-82, B-83
Elgen Corporation, The B-75
Ethyl Corporation C-4, C-5

F

Federal Process Company, The E-38
Fisher Governor Company E-10
Fleetline Company D-65
L. B. Foster Co. E-30
Foxboro Company, The D-10, D-11
Franks Division, Cabot Shops, Inc. B-53

G

Gardner-Denver Company B-4
Gaso Pump & Burner Mfg. Co. E-1-d
Gates Rubber Company B-5
General American Transportation Corporation, Plate & Welding Division E-11
General Electric Company B-93, E-15
Glidden Company, The A-9
Graver Tank & Mfg. Co. C-101
Guiberson Corporation, The B-7

H

H & M Pipe Beveling Machine Co. C-27
Halliburton Oil Well Cementing Company ..... Back Cover, B-48, B-49, B-95
Hammond Iron Works E-4
Harbison-Fischer Mfg. Co. B-150
Harshaw Chemical Company C-54
Hercules Tool Company B-139
Holcombe Company, Inc., The D-61
Hotel Figueroa E-37
Houston Oil Field Material Company, Inc. B-8
Hughes Tool Company E-1-c
Humble Oil & Refining Company B-145
Hycalog, Inc. B-131
Hydril Company B-41

I

Ingersoll-Rand C-51, E-37
International Harvester Company E-12
International Nickel Company, Inc., The C-97
Iverson Supply Co. B-154

J

Jensen Bros. Mfg. Co., Inc. B-156

K

Kane Boiler Works D-58
Koch Engineering Company, Inc. E-1-e
Koehring Division of Koehring Company E-13
Koppers Company, Inc. D-8, D-60
Kraloy Plastic Pipe Co., Inc. E-27

L

Lamar Hotel E-34
Lane-Wells Company ..... Inside Back Cover
Larkin Packer Company, Inc. B-105
Layne & Bowler, Inc. E-35
Lenape Hydraulic Pressing & Forging Co. C-118
Lone Star Steel Company A-5
Lufkin Foundry & Machine Company B-103
Lufkin Rule Company, The E-36

Mc

McCullough Tool Company B-51
McEvoy Company B-99

M

Mack Trucks, Inc. B-63
Magnet Cove Barium Corp. B-64
Magnetrol, Inc. C-121
F. H. Maloney Company D-54
John N. Martin, Manufacturer B-9
Martin-Decker Corp. B-152
Mason-Neilan Division of The Worthington Corp. C-78, C-79
C. A. Mathey Machine Works, Inc. B-157
Maxim Silencer Company, The D-59
Mid-Continent Supply Co. B-125, B-126, B-127, E-28, E-29
Minneapolis-Honeywell Regulator Company D-9
Moran Furnace and Sheet Metal Company C-116
Motorola Communications & Electronics, Inc. D-18, D-47
Mueller Company E-21, E-22

N

National Aluminate Corporation B-2
National Supply Company B-69, B-70, B-71, B-72
National Tank Company E-40
National Tube Division, United States Steel Corporation B-111
Natural Gasoline Supply Men's Association C-85
Nelson Electric Manufacturing Co. C-119
Nibco, Inc. D-58
Nooter Corporation C-59
Nordberg Mfg. Co. B-91, D-41
Nordstrom Valve Division, Rockwell Mfg. Co. E-1-a

O

Oil Center Tool Co. B-1
Oil States Rubber Co. B-98
Oilwell Supply Division, United States Steel Corporation A-7
Orbit Valve Company B-123
OTM Corporation E-1
Otis Engineering Corporation B-108

P

Pacific Coast Borax Company Division, United States Borax & Chemical Corporation E-39
Packed Column Corporation C-115
Parkersburg Rig and Reel Co. B-159
Parsons Company D-14
Peerless Manufacturing Co. A-13
Pelican Supply Co., Inc. D-52
Perforating Guns Atlas Corporation B-61
Petro-Chem Development Co., Inc. C-81
Petreco Division, Petrolite Corporation C-43
Petroleum Electric Power Association E-32
Pipelinings Division, American Pipe and Construction Co. E-37
Pipeline Cleaners Co. D-52
Pittsburgh Coke & Chemical Co. B-124
William Powell Company, The C-75
Procon, Incorporated C-73
Proportioneers Division, B-I-F Industries C-23

R

Radiator Specialty Co. C-122
Rector Well Equipment Company, Inc. B-79
Reda Pump Company B-98
Reilly Tar & Chemical Corporation D-56
Republic National Bank of Dallas A-1
Ridge Tool Company, The E-38
Rockford Clutch Division, Borg-Warner B-158
Rockwell Manufacturing Company B-136
Royston Laboratories, Inc. D-34
Rust-Oleum Corporation E-3

S

Schlumberger Well Surveying Corp. B-107
Scaville Manufacturing Company C-53
Shaffer Tool Works B-81
Shell Oil Company E-8
Sikorski Aircraft B-121
Solvay Process Division, Allied Chemical & Dye Corporation C-115
Southwest Industries, Inc. B-112
Southwest Industrial Electronics Co. D-7
Spang & Company B-135
Standard Oil Company of California E-14
Standard Oil Company (New Jersey) A-16
Stearns-Roger Mfg. Co. C-91
Steel Forgings, Inc. D-65
Stewart & Stevenson Services, Inc. B-100, B-101
Stitt Ignition Co. E-30

T

Tapecoat Company, The D-39
Texsteam Corporation B-132
Thompson Tool Company B-137
Thornhill-Craver Company B-117
Tretolite Company B-128, C-71
Tube Turns E-18-a, E-18-b
Tuboscope Company B-141

U

Union Asbestos & Rubber Company C-89
Union Switch & Signal Division of Westinghouse Air Brake Company E-1-f
Universal Oil Products Company C-56, C-57

V

Henry Vogt Machine Co. C-74

W

W. L. Walker Company D-65
Walworth Company E-1-h
Warner-Lewis Company D-37
Waukesha Motor Company B-119
Welex, Inc. B-130
Well Equipment Mfg. Corp. B-143
Western Company, The B-147
Westinghouse Electric Corp., Carrier-Microwave Department D-15
Wheeling Machine Products Company E-26
Wheland Company, The B-142
Wickes Boiler Company, The C-63
T. D. Williamson, Inc. D-66
W-K-M Division, ACF Industries B-114, B-115
Wilson Manufacturing Co., Inc. B-149
Wilson Supply Co. B-138
Wisconsin Motor Corporation E-23
Franklin C. Wolfe Co. C-34
Wright Chemical Corporation C-122

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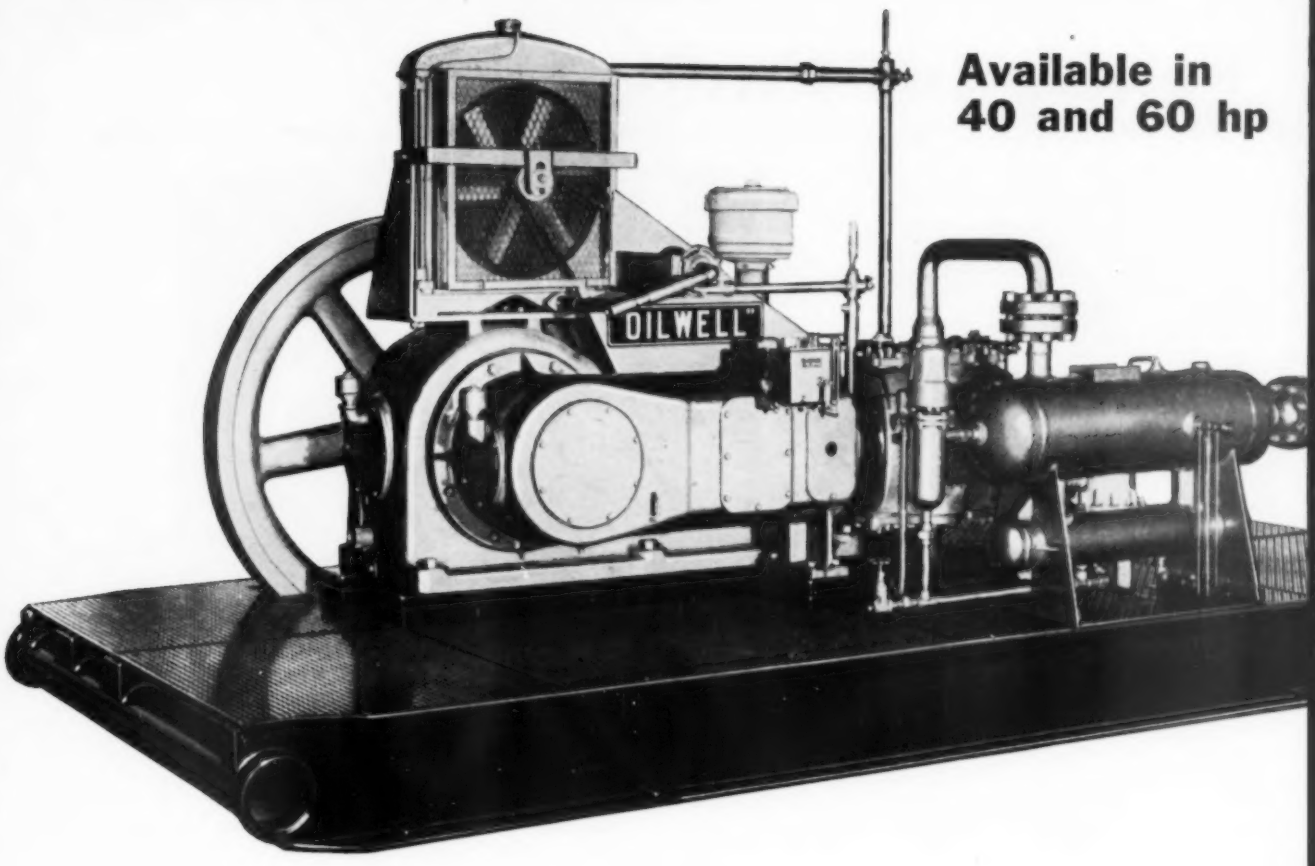

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Petroleum Profile

"SENOR PETROLEO" of Lima, Peru, is a great example of the geologists who search the unknown places of the earth for petroleum. Many of them are not as successful, however, as Douglas Fyfe. He brought in the first commercial oil well in the Amazon Basin in 1939 when Ganso Azul's well came in. It was on the Pachitea River, some 400 miles northeast of Lima. Eighteen years later, as geologist for the Peruvian "El Oriente" company, Fyfe was responsible for bringing in Maquia No. 1, roughly 100 miles to the north of the Ganso Azul field.

These discoveries are so far the only positive results obtained in the search for commercial oil sources in Eastern Peru where 16 companies and over 13,000,000 hectares of concessionary areas are now involved. Do you wonder that Fyfe is known as Sr. Petroleo in Eastern Peru?

DOUGLAS FYFE
Senor Petroleo

Fyfe was born in the village of Cucumonga, near Los Angeles, California, April 3, 1891. His father was a native of Edinburgh, Scotland, and his mother of Ottawa, Canada. Receiving his secondary education at the Harvard School, Los Angeles and the Institut Schmidt, St. Gallen, Switzerland, Fyfe graduated in geology from Stanford University, class of 1913.

He went to Colombia the next year for the old Standard Oil Company of New York and was employed in exploration work west of Cartagena and Rio Magdalena under the chief geologist, F. M. Anderson. Returning to the States late in 1915 he went to work for the Empire Gas and Fuel Company (Cities Service) out of Bartlesville, Oklahoma. He took part in the mapping of the Augusta and El Dorado structures, Kansas, and was later in charge of geological exploration in West Texas.

In 1917 he made an expedition to the Barco concession, Colombia, for Cities Service, with Sr. Barco and the well-known promoter "Fog-Horn" MacFadden. On the expedition several peons were killed by Motolone Indians but information gained resulted in Cities Service taking an interest in the concession.

Fyfe worked for a short period with the Doheny companies in the States before entering the army. When he was demobilized he joined the San Francisco staff of the General Petroleum Corporation and spent several years as exploration geologist in California and Texas.

During the years 1922 to 1936 he was associated with Robert B. Moran, as consulting geologist in Los Angeles. He acted as consultant and engineer in charge of drilling in southwest Colorado (Paradox Valley) and in the boom time of Southern California's town-lot developments in Santa Fe Springs, Huntington Beach, and Signal Hill.

In 1929 Moran returning from a trip to Peru reported that during a flight from San Ramon to Masisea, east of the Andes, he had seen what appeared to be an anticlinal structure. When asked by an inquiring reporter: "How did you recognize it from the air as a structure?" Moran's memorable reply was "How do you recognize a cow?"

At the suggestion of Moran, Fyfe went to Peru and made a trip by mule-back from San Ramon, end of the railway and highway route across the Andes from Lima, over the Pichis trail and down the Pachitea River by canoe with the object of "rediscovering" the area seen by Moran. The anticline was located on the Pachitea watershed, just above the confluence of this river with the Urubamba, to form the Ucayali. Six hundred miles to the north the Ucayali joins the Marañon to form the Amazon.

Fyfe made a detailed geological exploration of the region. Oil seepages and favorable conditions for the accumulation of oil were encountered. The area was recommended for drilling, a concession was acquired in the name of the Selden Breck Construction Company, of St. Louis, and surveys, involving the making of astronomical observations, were carried out.

After a considerable delay caused by the depression of the early 1930's and the conflict between Peru and Colombia over ownership of the settlement of Leticia and adjacent territory on the Amazon, a group headed by the Seely Mudd family of Los Angeles was formed, and the Cia. de Petroleo "Ganso Azul" with William McDuffie as president took over the Selden Breck concession. Drilling & Exploration Company was contracted to drill an exploration well. Fyfe was in charge of the drilling and after oil was discovered in the second well, he remained in charge of development as vice president and manager in Peru until 1940.

From 1940 to 1945, Fyfe was under contract with the Peruvian government as chief of exploration in connection with geological research in Eastern Peru.

In 1945, Cia. Peruana de Petroleo "El Oriente" S.A., was formed by the late Augusto Gildemeister, a member of the family owning Peru's largest sugar estates, to explore Eastern Peru. Fyfe became geologist and exploration manager of the company and in that capacity located the field which caused such a sensation in 1957.

This is the word portrait of an explorer — a man, who is as much at home in the enclosing forests of Peru as in the derrick jungles of Signal Hill. This is Douglas Fyfe — Sr. Petroleo.

How Glidden can help keep your equipment out of industry's costliest scrap pile

Glidden VINYL-COTE maintenance coating system offers maximum corrosion resistance where operating temperatures are below 170°F. Ideal for protecting metal, concrete, masonry and wood surfaces from the most severe exposure to acid and alkaline conditions. Provides long-lasting flexibility, adhesion and toughness plus excellent color retention and chalk resistance. Easy to apply, dries quickly.

Glidden NEV-A-RUST system is excellent for protecting metal surfaces subjected to normal or mild chemical conditions. Primer contains rust-inhibitive pigments, provides good surface wetting, fast air dry. NEV-A-RUST finishing coats offer outstanding gloss and color retention and durability.

These are but two of the many protective coating systems offered by Glidden—each specifically engineered to provide positive protection at lowest maintenance cost per foot per year. Let Glidden recommend the system that will solve your particular corrosion problem.

Write now (company letterhead, please) for folders which contain complete information on Glidden VINYL-COTE and NEV-A-RUST maintenance coating systems.

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THE CONFERENCE TABLE

*Where there is no free agency, there can be no morality . . . . . PRESCOTT**

The Fall of Western Civilization

Ancient Peru provides mankind with one of history's great lessons.

The story briefly is this. Following some 5000 years of developing culture came the Inca Empire. In a mere 55 years (1438-93) it grew from the small city-state of Cuzco until it spilled over Peru and Ecuador. The architecture and road system of the Andes kingdom are among the wonders of the world. Even more impressive were the social advancements of the benevolent despotism of the Inca Dynasty. There was a well organized and well run welfare state, with an established church and educational system, a surgical science that we still learn from today, a craft of weaving that embraced virtually every known technique. An example of their metal craft is on exhibit in the U. S. It is the Crown of the Andes, carved from a solid block of gold and set with emeralds. It is valued at $4½ million.

It was the Western Hemisphere's greatest government, one of the outstanding empires of all history. The dynasty lasted some 330 years, yet it fell to 177 soldier adventurers.

Why?

The ruler, Atahualpa, had supreme and absolute authority. Administrators and executors of the government were efficiently organized but the line of responsibility ran clearly and rigidly to the "Unique Inca," a fitting title. Everyone in the empire was dependent for position, shelter and food upon one man.

When the Spaniards held the Emperor prisoner he offered to fill a large room with gold for his release. The room was not yet filled when he was strangled. After a few skirmishes, like the threshing of a beheaded snake, the empire died.

Who could assume authority? Who would command the thousands of trained soldiers? To whom could government administrators deliver their problems and receive decisions in return? There was no one, so the greatest Western Hemisphere civilization of that time fell when one man was killed.

What would you consider the lesson of this historic fall from power? Here's our version: The larger the responsibility and authority among the people at the base of a governing organization, the greater its hopes of survival. If all power and responsibility rest in Washington, only one missile could destroy another Western civilization.

Creative Course Scheduled

A new school for management has been set up in Taos, New Mexico, by TICO—Taos Institute of Creative Orientation. The idea is to give specialized personnel a guided tour of abstract thinking.

Information, Please!

Bayonne refinery has announced the installation of a new telephone device to get plant news developments to supervisors almost as soon as they happen. By dialing a specified number, supervisors will hear a recorded 30-second message giving the latest developments of interest to them.

New items are recorded on this telephone device as often and as soon as they occur.

*From "The Conquest of Peru" by William Hickling Prescott.

Engineers Will Be Scarce

"Greatly improved utilization of engineering talent is the only solution to the problem posed by the coming drop in the male labor force which will result in 700,000 fewer men aged 25-34 in 1965 than we have right now," said Garvin H. Dyer, president of the National Society of Professional Engineers.

He explained "the drop in births during the depression years of the 30's will definitely be reflected in a drop in the number of men in the younger age brackets by 1965." In the coming five years management must work out the problem of using engineers to their full capability. To waste technical talent and training simply means wasting money.

Du Pont People Live Longer

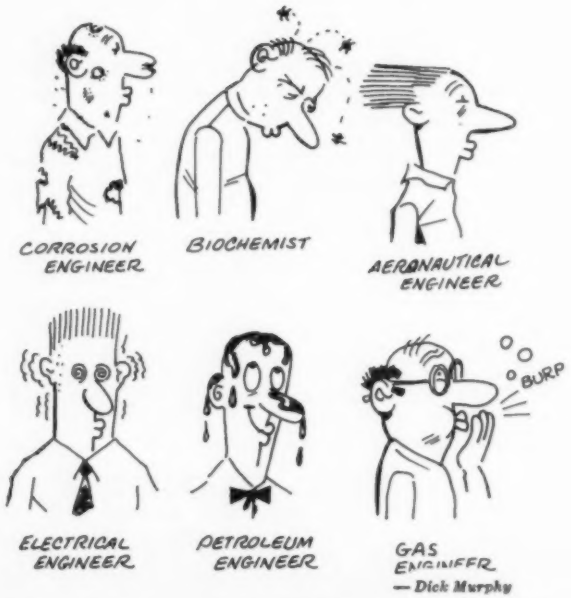
The most interesting industrial health study to come our way is the 4-year survey on the 90,000 employees of Du Pont. Death rate, for instance, was only 68 percent of national normal.

This followed in every category of illness. Deaths from cancers among Du Pont employees was 86 percent of the national average; from diabetes only 8 percent.

More Du Pont people have heart attacks in summer than in winter. This is contrary to other studies which report a higher incidence in winter months. They also found that hypertension is no greater among executives than among wage roll people, contrary to general belief.

Another phase of the study shows that the rate of heart attacks for "normal" employees is about 2.3 per 1000 people. For overweight people the rate is about 50 percent higher and for those with hypertension it is about 70 percent more. But for people who have both, the risk of heart attack jumped to three and one-half times.

ENGINEERING TYPES



— Dick Murphy

Where Best to Cut Costs

As Socony Mobil's *The Flying Red Horse* reports, the last thing the company seeks is an over-cautious, penny-wise and pound-foolish approach to the job. There are ways to cut costs, however, and here are two phases to consider:

Some increased costs reflect better employee benefits. Recent improvements in the employees savings plan and the retirement annuity plan, for example, mean substantial increases in expense. Obviously, neither the company nor the employee wants cuts here. The place to cut exists in many other areas. For example:

- *Reducing waste.* What's a tiny leak in an oil pipeline worth? One drop leaking every second wastes 12 bbl of oil a year. Just as wasteful is the long distance phone call made when a letter or teletype message would have sufficed. Or the field trip that wasn't essential.
- *Imagineering.* That simply means using your imagination to devise more efficient ways to do a job.

Why not, for example, use a lighter gage steel for the smaller drums of lube oil and grease? Packaging men tried it, found the lighter steel did the job; and the traffic department then obtained approval for its use in rail and truck service. Savings: $40,000 a year.

Why, too, should catalysts for the Thermofor catalytic cracking units at refineries be shipped in bags? The traffic department wondered — and now catalysts are often shipped in bulk in covered railroad hopper cars. Result: A saving of almost $350 for each carload shipped.

And how about those costly shutdowns? Can they be cut by introducing new equipment? Refinery engineering had that problem when catalyst lift-pipes on the TCC units kept wearing out every nine months or so. To lick it, engineers had more than 100 pipe samples tested at Paulsboro Research and Development Laboratory. Result: They found a high-chrome iron pipe that's more wear-resistant than carbon steel; it's gone four years without replacement and promises to last three or four more.

Opportunities like this are everywhere, whatever your job. Fred J. Hander, as an engine room wiper on a tanker, saved the company nearly $8000 in a single year by proving that plastic pipe and plastic pipe fittings could do the job of brass in certain engine room cold-water lines. Similarly, John Hunter, a senior group leader of the cost section at Brooklyn refinery, persuaded the company to adopt a new debris-removal system that saved $14,000 the first year.

The 1958 situation calls for this kind of alertness all along the line. With alertness, loyalty and skill, Mobil employees have met the challenges of competition many times in the past. The 1958 competition promises to be the toughest since the war — but it's a challenge that Mobil people, working together, will meet.

Do You Know Your Words?

Weatherford Oil Tool Company has the right idea. The firm sent nine executives to a general semantics institute in Connecticut the first of the year. We've always believed that a fundamental need of business and pleasure was an understanding of words and their use.

Words can soothe or roil — can bring optimism or defeat. Remember that just one not-very-good book — by Karl Marx — has set one half of the world against the other. Don't ever discount the value of any word you use.

Objectives of the semantic seminar are to promote creative thinking and to expand leadership qualities. The science of words — basic in communication — can certainly help reach these goals.

A Blow to Editors

A good editor usually views a steady job complacently. It takes so long to learn the business — like how to spell "sesquipedalianism" — that one is seldom fired.

An IBM news release has changed all that. Even here at *The Petroleum Engineer* editors are getting in only 20 minutes late and bending a pencil instead of an ear.

It seems International Business Machine researchers have come up with an editing computer. Technical and scientific articles are analyzed by the computer — it then selects the most significant sentences and reproduces them on an electronic printer.

We've known all along we weren't born a minute too soon, but this almost convinces us we got here about 20 years too late.

Some Interesting FACTS about our last 6% General Wage Increase

For example, it is approximately equivalent to a little more than three weeks' extra pay for every domestic employee in the course of the year . . .

That amounts to about $6 million annually . . .

In our industry, price increases cannot always be passed along to the customer. When they cannot, the $6 million must come out of company profits . . .

To take in an extra $6 million we would have to sell . . .

an extra 41 million gallons of gasoline . . .

or 58 million gallons of furnace oil . . .

or 30,400,000 quarts of motor oil.

And, of course, $6 million added sales is a very long way from $6 million restored profits.

And—$6 million would buy any one of the following items:

One hundred complete service stations . . .

Four water terminals . . .

Ten pipeline terminals . . .

Thirty 100,000 barrel storage tanks . . .

258 oil delivery trucks . .

Four power barges . . .

150 miles of 8-in. product pipeline . . .

Two office desks for every employee . . .

Three steel filing cabinets for every employee.

It is generally agreed by economic experts that wage increases without a corresponding increase in productivity will lead to inflation.

From *The Atlantic Magazine*, publication of Atlantic Refining Company, November 1957, George P. Hopkins, editor.

HIGHLIGHTS ★ ★ ★

Digest of News and Comment

Import Control: Two Men

Mandatory crude import controls would impose few administrative problems, says Texas Railroad Commissioner Lt. Gen. E. O. Thompson. The state oil regulatory body veteran, who favors compulsory controls, indicated that incoming oil could be prorated as easily in the U.S. as it is in Texas. "One man and a clerk could do it," General Thompson told a Dallas (Texas) Times-Herald editor recently.

Memphis Case: No Hurry

U.S. Supreme Court has denied a Justice Department request asking for quick action concerning the Memphis Case. It has, however, agreed to review the decision given by a U.S. Court of Appeals in Washington, D. C., involving Memphis, Tennessee. The original ruling would have made it necessary for a gas transmission company to receive permission of all its customers before raising rates.

Tidelands Hearing October 16

The tidelands boundary dispute will go before the U.S. Supreme Court October 16, the Justice Department reports. At that time the Gulf states may present their case for establishing a 10½-mile offshore boundary. The JD is seeking to establish a three-mile state limit. Texas officials indicate that they will argue for "separate consideration" at that time, because of historic grants to Texas made by Mexico.

NPC Gives Transport Data

A valuable study on petroleum transportation facilities in the U.S. has been released by the National Petroleum Council. The report includes details on all pipelines and pipeline capacities, railroad tank car movements, tank truck movements, barge and lake tanker statistics and a separate study of all facilities of transportation of LPG. Copies of the 87-page report, complete with maps, may be obtained without charge through J. V. Brown, secretary-treasurer, National Petroleum Council, 1625 K Street NW, Washington 6, D.C.

Yemen Agreement Cancelled

You've got to be fast if you want to stay in Yemen, an isolated kingdom on the Arabian Peninsula. U.S. interests have received word that a two-year-old concession held by the Yemen Development Corporation has been nullified by absolute ruler Imam Ahmed. The ruler has stricken his name from the agreement, although the concession has not yet been formally revoked. Company officials say there is little to do but leave if so ordered. Informants say the Imam grew impatient, not being familiar with oil-finding techniques, in that he has not yet seen oil or dollars he had expected to see pour in.

Grain Gasoline Back Again

Wheat-producing states are again pushing for legislation aimed at forcing gasoline refiners to add five percent grain alcohol to all motor fuels. Claims are that this additive would (1) solve the farm problem, (2) eliminate grain surpluses, and (3) yield better auto mileage and give a "smoother" ride. Tests last year indicated that use of the alcohol in gasoline in an amount necessary to help use up any large quantity of grain would make gasoline prices exorbitant. Perhaps this group could figure out a way to solve some oil problems, too.

Rights Include Metals

A Florida state circuit court has ruled in favor of Coastal Petroleum Company, giving it rights to all minerals found on its 4,500,000 acres of submerged land leased from the state. Minerals include oil, gas, sulfur and potash, rutile, ilmenite, monozite, zircon and titanium. No mineral discoveries on these lands have been made, however, since the state granted the lease in 1947. Coastal, a subsidiary of Coastal Caribbean Oils, has offshore leases extending from the shoreline between the Apalachicola River and Port Richey, 10.3 miles into the Gulf of Mexico.

World-Wide Oil Surpluses

Imports cannot take full responsibility for present depressed condition of the domestic oil industry, revealed a committee formed by Texas Governor Price Daniel to study industry's problems. A spokesman for the group, Dr. Philip E. Coldwell, economist for the Dallas Federal Reserve Bank, said a general recession combined with world over-supply of petroleum is depressing the domestic industry. Supplies of both crude and refined products have increased all over the world. "This problem of over-supply will exist for a substantial time to come," he said, urging the industry to "take a long-range view of world oil problems."

What OCAW Wants

In February a bargaining policy board of Oil, Chemical and Atomic Workers Union set these goals.

Higher wages—an increase to equal rise in cost of living and a 3½ percent increase which the union contends "is the annual increase in output per man hour of the average American laborer."

Longer term contracts—2 or 3 years —with some increases annually.

Contract clause that states company must notify union four months in advance of any layoff involving five percent or more of any particular bargaining group. This provision would also permit union to reopen contracts for bargaining on wages and hours.

Substantial severance allowance to employees being laid off.

Better health benefits.

An optional program included:

1. Negotiation of standby agreements providing that hours of work will be reduced as an alternative to layoff of present employees.
2. Curtailment of overtime work, with the negotiation of provisions that overtime work shall be offset by employee taking compensating time off his regular hours later.
3. Establishment of joint union-management controlled training programs to equip members for new skills required by technological advancements.
4. Full company payment of costs of pension plans, hospitalization and medical plans, insurance and other such benefits.
5. Pension fund monies to go to the individual account of employee, so that if he leaves his employment before retirement age he may collect such funds.

Iran Production Exceeds Mark

The Consortium operating Iran's oil industry surpassed its guaranteed oil delivery by 11.4 percent in 1957. The group shipped abroad or delivered to the Abadan refinery over 245,000,000 bbl of crude oil last year. This is equivalent to nearly 39,000,000 cu meters; guaranteed delivery under the Consortium agreement is 35,000,000 cu meters. The contract-year (ended January 28, 1958) production is expected to be about the same as that of 1957.

OPERATION PROVES
It's Cleaner Gas with
PEERLESS
SCRUBOSPHERES

Operation of these four 66" I.D. Scrubospheres has demonstrated their superiority over oil bath dust scrubbers. The dust removal ability of the SCRUBOSPHERE is outstanding because it utilizes wetted surfaces for dust collection which are more closely spaced than in conventional equipment.

Operation of these Peerless units has also proven their superiority with respect to minimum oil loss, because oil is periodically removed from the Scrubospheres whereas **it must be periodically added to other scrubbers** in the same plant operating under comparable conditions.

Let your Peerless Representative give you full details.

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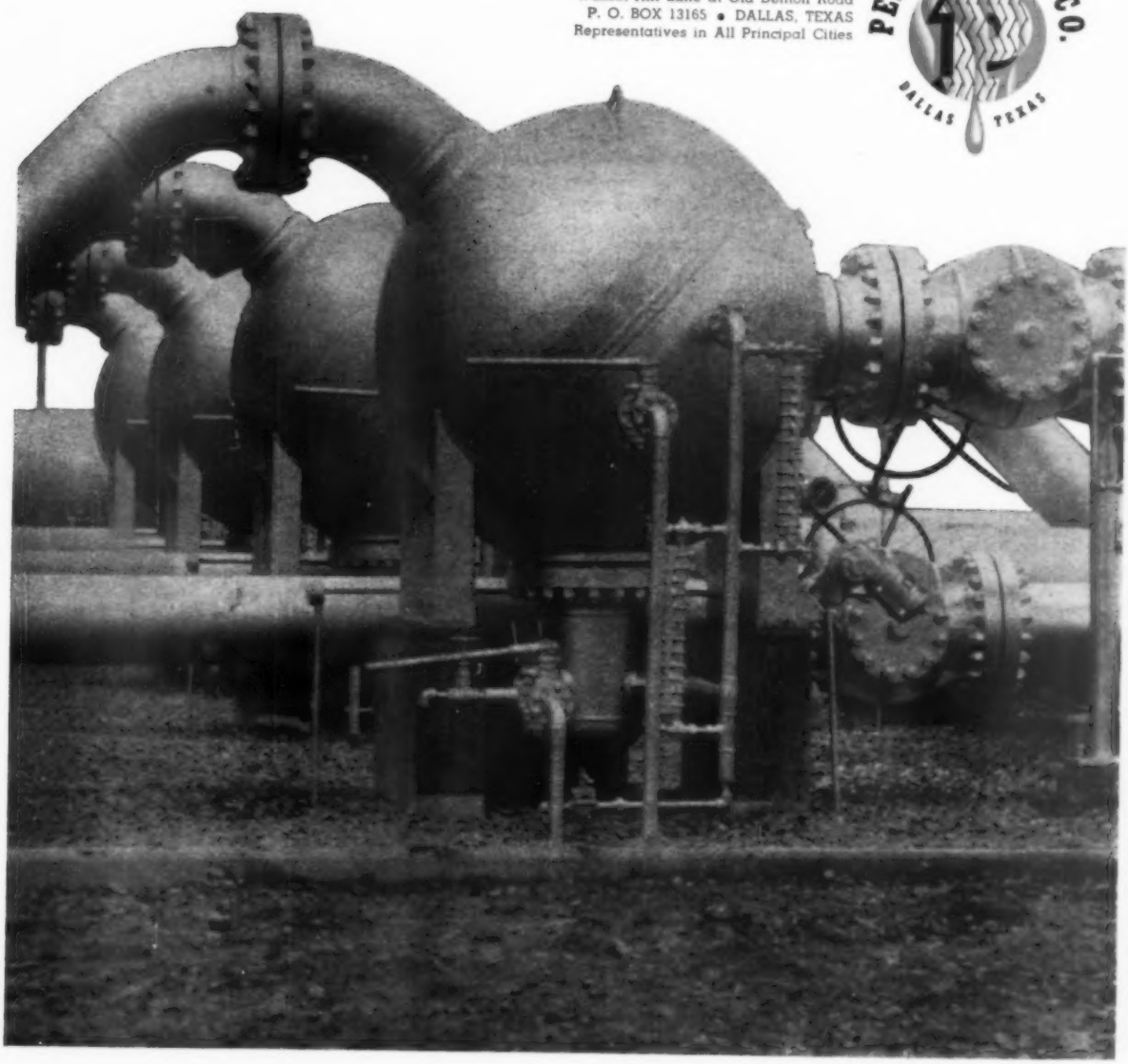

Business Outlook 1958

● Strong end product demand — department store retailing only 2-3 percent down . . . food and drugs sales up . . . automobiles down — *Myron S. Silbert, vice president, Federated Department Stores, Cincinnati, Ohio.*

● Construction strong — total 3 percent up for year . . . first rise in residential building (7 percent) since 1955 with "starts" forecast as 1,090,000 — *Donald D. Couch, vice president, marketing and commercial development, American Radiator and Standard Sanitary Corporation.*

● Capital goods sector down — is slowest to move . . . Capital goods recession — not inventory . . . Capital investment (excluding agriculture) estimated at $32 billion — a 13 percent decline . . . Public utilities will boost spending — *Louis J. Paradiso, assistant director— chief statistician, Office of Business Economics, U. S. Department of Commerce.*

● Manufacturers cut inventories of $7 billion annual rate in January . . . Haven't touched bottom yet . . . Recession beginning to exercise corrective influence on prices, wages, costs . . . 1958 will be a good year. — *Martin R. Gainsburgh, chief economist, The Conference Board, New York.*

● World's biggest business — U. S. government will spend at annual rate of $90 billion for goods and services . . . delayed spending in fourth quarter '57 means impact for much heavier spending lies ahead — *Samuel M. Cohn, chief of fiscal analysis, Bureau of the Budget.*

These are the considered opinions of men who should know. They were given at a session of National Industrial Conference Board at Dallas, Texas, March 20, 1958.

Dr. Carlos Perez de la Cova, new minister of Mines and Hydrocarbons for the government of Venezuela, has been visited by our voluntary imports plan administrator Capt. M. V. Carson. Perez, who in the past has served as minister counselor for petroleum affairs of Venezuela at the Washington Embassy, has had much to do with establishment of good petroleum laws, since used as a pattern for those of other countries. Perez's thinking on petroleum matters is covered in the interview in The Petroleum Engineer, November, 1957, Page A-27.

What it's oil about: To help foreign visitors understand the workings of operations in the U. S. oil industry, Sun Oil Company hosted a tour of 32 foreign lawyers and special guests to a one-day tour of parts of the East Texas oil field. The trip made by visitors, which represented 22 nations outside the U. S., was in cooperation with the Southern Methodist University School of Law, where the top lawyers are now attending special courses of the Academy of American Law and the Law Institute of the Americas. In the background above the group shown here are derricks in downtown Kilgore, Texas.

Texas Output Lower than Low

Another record low oil production month has been set for April by the Texas Railroad Commission, but Texas independent oilmen are not too blue. In fact, most producers had urged the Commission to adopt the 8-day producing schedule — lowest allowable rate since June 1950. Concensus of opinion at the rate-setting hearing in Austin was that the "worst will be over in April." Permissible flow in April will be 2,444,571 bbl per day, a drop of 1,400,000 bbl per day below the March 1957 quota. Other southwestern states are holding producing schedules near the March rate.

Meetings

Apr. 20-23—**American Institute of Chemical Engineers,** regional meeting, Sheraton-Mt. Royal Hotel, Montreal, Can.

Apr. 20-24—**Scientific Apparatus Makers Assn.,** annual meeting, El Mirador Hotel, Palm Springs, Calif.

Apr. 21-23—**API Division of Production,** Rocky Mountain district, Cosmopolitan Hotel, Denver, Colo.

Apr. 27-29—**Independent Petroleum Assn. of America,** midyear meeting, Sherman Hotel, Chicago, Ill.

Apr. 27-30—**AAPG,** Rocky Mountain section, 8th annual meeting. Casper, Wyo.

Apr. 28-29—**Automatic Control in the Petroleum and Chemical Industries,** short course, sponsored by the School of Electrical Engineering, University of Oklahoma, Norman, Okla.

Apr. 29-May 1—**PIEA-PESA,** joint convention, Adolphus Hotel, Dallas, Tex.

May 5-6—**Society of Petroleum Engineers of AIME, North Texas section,** biennial secondary recovery symposium, Wichita Falls, Tex.

May 5-9—**API Safety and Fire Protection Committee,** midyear meeting, Cosmopolitan Hotel, Denver, Colo.

May 7-9—**API, Division of Production,** Eastern district, Deshler Hilton Hotel, Columbus, O.

May 8-9—**Texas Petroleum Research Committee,** Oil Recovery Conf., Townes Hall or Batts Auditorium, University of Texas, Austin, Tex.

May 9—**AIChE,** symposium of local sections in Ohio, plus Pittsburgh and Detroit, Commodore Perry Hotel, Toledo, O.

May 11-15—**ASME,** Oil and gas power conf. & exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

May 12-16—**API Division of Refining,** midyear meeting, Statler Hotel, Los Angeles, Calif.

May 19-23—**National Fire Protection Assn.,** 62nd annual Palmer House, Chicago, Ill.

May 21-22—**WPRA,** southwest regional technical-industrial relations meeting, Hotel Paso del Norte, El Paso, Tex.

May 22-23—**API Division of Production,** Pacific Coast district meeting, Biltmore Hotel, Los Angeles, Calif.

June 2-4—**Petroleum Electric Power Assn.,** Texas Hotel, Fort Worth, Tex.

June 2-7—**Seventh International Mechanical Engineering Congress,** Scheveningen, Neth.

June 2-7—**ASTM** Committee E-14, meeting on Mass Spectrometry, Jung Hotel, New Orleans, La.

June 8-13—**API Division of Production,** midyear committee conf., Hotel Deauville, Miami Beach, Fla.

Good Wells Make Good News

A Monthly Report Of Successful Well Treatments

April, 1958

For versatility to meet a wide variety of well conditions, the nine basic Dowell fracturing services deserve serious consideration. Here are some reports on recent treatments showing what has been achieved when the correct service was used.

- **San Juan County, New Mexico.** (Old gas well) This well was completed in the Point Lookout sandstone from 5468 to 5532 feet. Production had decreased to three mmcfd. Before treating with Riverfrac® operator set five-inch liner and perforated six shots per foot. Dowell used nine rubber tanks to hold the water and six Allison pumpers to inject 135,000 gallons fresh water and 50,000 pounds sand *at 110 bpm. On four-hour test after treatment, well produced at the rate of over 36 mmcfd.*

- **Webster Parish, North Louisiana.** (New oil well) This well was completed in the Justiss sandstone through perforations from 9296 to 9321 feet. It swabbed ½ boph before treatment. Working with Dowell, the producer selected a multi-stage treatment designed to prevent troubles from silicate swelling. Treatment was basically Stratafrac®, using acid-kerosene emulsion as fracturing fluid; plus Mud Acid, regular acid with surface tension and silicate control agents, and perforation ball sealers. *After treatment, well potentialed 190 bopd.*

- **Southeastern Saskatchewan, Canada.** (New oil well) This well was completed in the Midale Beds limestone through perforations from 4409 to 4419 feet. After first acidizing, well swabbed 100 per cent water. Following remedial work, a second acid treatment resulted in only 10 to 12 barrels fluid (85 to 90 per cent water) per day. Operator then called in Dowell and ordered Acid Petrofrac®, injecting 5000 gallons acid-oil emulsion and 3000 pounds of sand down casing at 5 bpm. Because of corrosive waters, treatment was spearheaded with Corban® corrosion inhibitor in crude and followed with Corban and Freflo® in crude. *On last test, well was pumping 28 to 30 bopd with only 15 to 20 per cent water.*

- **Wayne County, Ohio.** (New oil well) Completed open hole in the Clinton sand, this well tested only a show of oil and gas. Operator selected Petrojel®, using 8000 gallons jelled crude and 16,000 pounds sand. Injection rate was 28 bpm at 1950 psi. After treatment, load was quickly recovered and *two weeks later the well was flowing 100 bopd with one mmcfd.*

Your Dowell engineer is prepared to give you complete information on any of Dowell's many fracturing services. Call any of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write Dowell Incorporated, Tulsa, Oklahoma.

Services for the oil industry DOWELL

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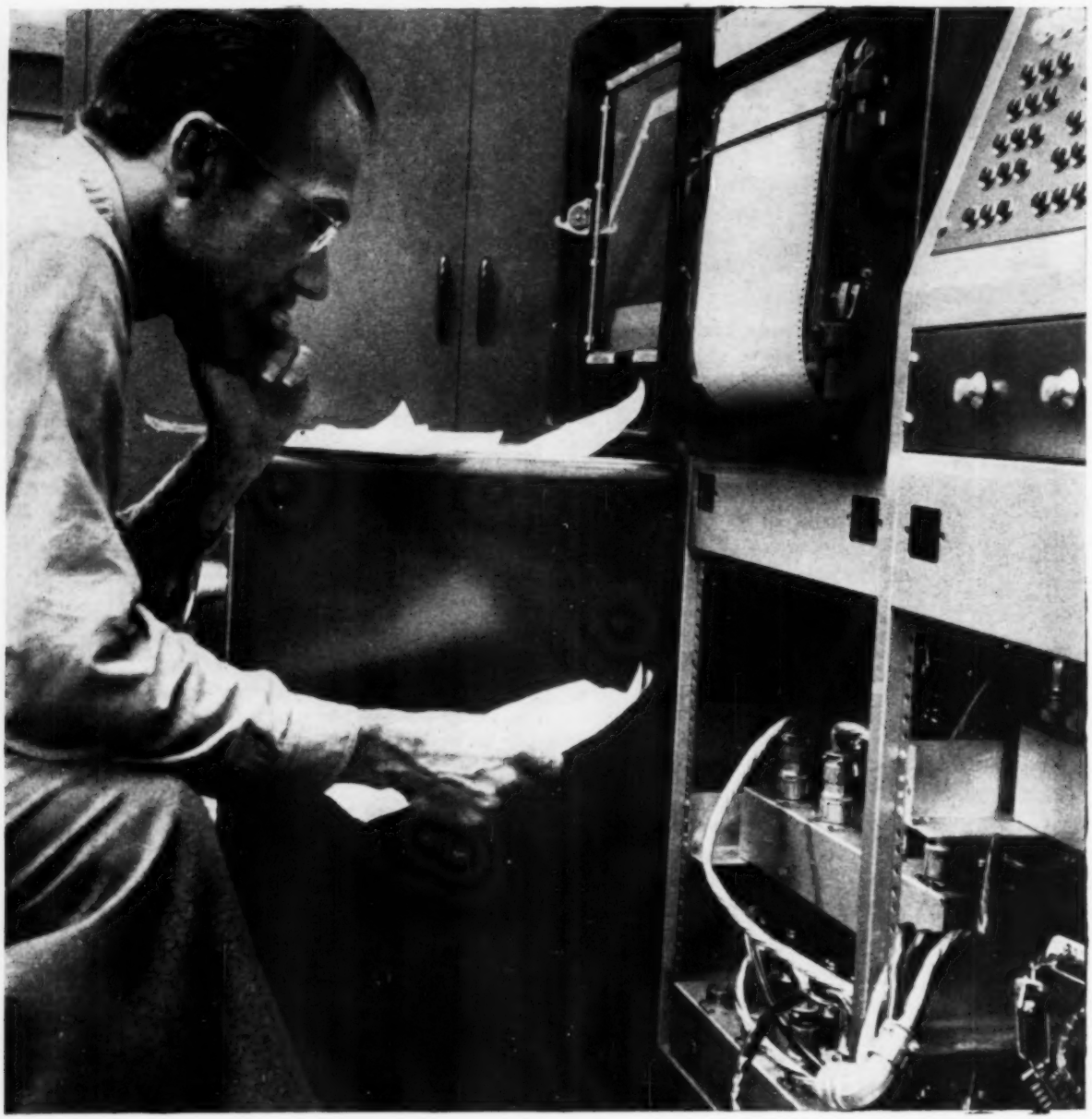

"One of the main roads leading to higher levels of efficiency is that of technical progress — not day-to-day routine engineering and research, but rather bold, imaginative and freshly creative research methods. By taking full advantage of the technical progress we have made so far, and by vigorously pressing forward new frontiers of technical knowledge, the domestic producer can help open up a whole new and more profitable era."

— M. J. Rathbone, President, Standard Oil Company (New Jersey)

Esso

STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES

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You Can Buy It in Peru

More and more materials and equipment are bought on the spot

Supply and Service Companies in Peru

E. S. DELANEY, S. A.
Representative for: The Vapor Recovery Systems Company (tank gage systems); Granberg Corp. (meters and pumps); O.P.W. Corp. (valves, fittings and assemblies); Metal Hose and Tubing Co. (hose).
Lima: Avenida Grau 290. Ulrich Willie, sales manager.

ENRIQUE FERREYROS & CIA., S. A.
Representative for: The Hilliard Corporation.
Lima: Apartado 150, Beyta 387. Cable: Ferreyco. Ing. Geoffrey Knight, manager, sugar department.

GARDNER-DENVER CO.
Lima: Apartado 674. J. J. Mastrovich.

GEOPHYSICAL SERVICE, INC.
Lima: Av. Tacna 329, Oficina 301-302. Telephone 24-617. Cable: GEESYE Lima. Don W. Rockwell.

GROSS EQUIPMENT, S. A.
Distributors for: American Sand Banum Co. Inc., (Scale control compounds for boiler tubes, scale and rust controls for cooling systems and radiators. Rust preventor for metallic surfaces); Armstrong Machine Works (Steam and air traps for refineries, gasoline, steam plants); Axelson Manufacturing Co. (Sucker rods, hollow sucker rods, polished rods, pumps, seats and balls, hydraulic pumping systems); S. R. Bowen Co. (Oil well tools); Chiksan Export Co. (Swivel joints, rotary hose, loading arms); Cardwell Manufacturing Co., Inc. (Drawworks and workover rigs, servicing hoists, trailer rigs); Eason and Therolf Tool Co. (Slush pump liners, rods, valves, seats); R. J. Eiche and Associates, Inc. (Export agents for oilfield supplies); Elliot Co. (Tube cleaners, expanders); Gadco Products, Inc. (Gadco pulsation dampeners and shock arrestors); Globe Oil Tools Co. (Drilling bits, junk catchers); Grant Oil Tool Co. (Bailers, reamers, scrapers); Gulf Coast Machine and Supply Co. (Christmas trees, well heads, tubing heads); Hamer Oil Tool Co. (Line and plug valves); Jet-Lube Inc. (Special lubricants); Johns-Manville International Corp. (Packings for every oilfield need, insulating material, transite pipe); Keystone Tool Corp. (Butterfly valves); Lubrikup Company, Inc. (Composition cups and cup-type packings); Mid-Continent Supply Co. (Oilfield supplies); Peerless Pump Division (Pumps for all purposes and liquids); Stardrill-Keystone Co. (Spudders, drilling tools); Transport Trailers, Inc. (Gooseneck and low bed trailers for any capacity); Web Wilson Oil Tools (Tongs, elevators, slips, hooks, connectors); Winslow Engineering Co. (Fuel and oil filters and filter elements); Val R. Wittich Jr. Inc. (Export agents for oilfield supplies). Well Equipment Manufacturing Corp. (Weco unions, blocks, burners).
Lima: Apartados 677 and 1869, San Demetrio, Ocona 160. Telephone: 31200-36023. Cable: GROSSEQUIPMENT. Walter M. Gross, manager, Carlos H. Weber, sales contact.

HALLIBURTON OIL WELL CEMENTING CO. OF PERU
Talara: c/o International Petroleum Company, Ltd. Cable: HALLIBURTON-TALARA. H. G. Bahner, manager.

INTER-CONTINENTAL TRADE COMPANY, S. A.
Representatives for Continental-Emsco Company.
Lima: Casilla 2657, Avenida Techa 320. Telephone: 32-206, 32-207, 36-602. Cable: ICONSA. Luis P. Navarro, managing director, Ing. Oscar Espejo C., assistant manager.

INTERNATIONAL GAS LIFT, S. A.
Representatives for: Clark Bros., Div. of Dresser International; Harbison-Fischer, Lufkin Foundry and Machine Company; Oil Metering and Processing Equipment Corporation; Pacific Pumps, Inc., Div. of Dresser International; Kimray, Inc., Camco, Inc. (gas lift); Barton Instrument Corp.; Bonney Forge and Steel; Tretolite, Inc.; Texsteam Corp.; Southwest Oilfield Products, Inc.; McEvoy Co., Lane-Wells Co.
Talara: Apartado 71. Cable: INTERLIFT, Talara. John V. Herasimchuk, Jimmy L. Wyche.

OIL WELL EQUIPMENT AND MATERIAL CONSULTANT
Represents: H. C. Smith Oil Tool Company (two, three and four cone rock bits, hole openers and reamer-type rock bits. Exclusive agent for Ecuador, Peru, Chile, Argentina, Uruguay, Paraguay, Brazil, and Bolivia); Ideco, Inc., one of the Dresser Industries (drilling rigs, workover units — the Rambler drilling rig for shallow, medium or deep drilling. Exclusive agent for Peru, Bolivia, Uruguay and Paraguay.)
Lima: Edif. Moncayo 75, Avenida Tacna 338. Telephone: 42-418. Cable: POOLE. E. R. Poole, owner.

PETROLEUM INDUSTRY SUPPLY COMPANY
Representative for: Ideco, Inc., Div. of Dresser International.
Lima: Oficina 75, Avenida Tacna 338. Telephone: 42-418. Cable: POOLE.

PETRO TECH DEL PERU
Technical oil field services; perforating, well logging.
Talara: Gordon N. Preudhomme.

SCHWAB, GEORGE E.
Representative for: Jensen Bros. Mfg. Co., Inc. (oil well pump jacks). Winston Steel Works, Inc. (industrial buildings). Western Plastics Corp. (polyethylene and kralastic piping). Murphy Diesel Co. (diesel engines). Miami Sales and Export Co., Inc. (general purchasing.) Representative for the foregoing firms (with exception of Murphy Diesel Co.) in Chile, Bolivia, Ecuador, Colombia and Venezuela.
Lima: Edif. Nazarenas 34, Avenida Tacna 411. Cable: SCHWAB. George E. Schwab.

SERVICIOS PETROLEROS, S. A.
Representative for: Bowen-Itco, Inc.; Byron Jackson Tools, Inc.; Byron Jackson Pumps, Inc.; Cameron Iron Works, Inc.; Franks Division, Cabot Shops, Inc.; Garrett Oil Tools, Inc. (Div. of U. S. Industries); Hammond Iron Works; Monarch Engineering Corp.; Oil Well Manufacturing Corp.; Oil Base, Inc.; Security Engineering Division (one of the Dresser Industries).
Lima: Apartado 1079. Telephone: 3-3877. Cable: SERPET. Guido De Rossi, Stanley W. Parfet.
Talara: Apartado 93. Telephone: Negritos 8. John Millea.

NATIONAL SUPPLY COMPANY
Lima: Sociedad Mercantil Internacional, S. A. Edif. "Fenix-Wilson," Esquina Quilca. Cable: COMERIN.

A. Y. F. WIESE, S. A.
Representative for: Oil Well Supply Division, United States Steel Corp.; American Iron and Machine Works Co., Inc.; Black, Sivalls and Bryson International, S. A.; Abegg and Reinhold Company.
Lima: Wiese Building. Cable: WIESE.
Talara: Apartado 90.
Telephone: 122. Av. McQueen 47. Negritos.

ADDITIONS TO SOUTH AMERICAN SUPPLIERS

NATIONAL SUPPLY COMPANY
Suppliers and manufacturer of a complete line of drilling and production equipment, also tubulars for the oil and gas industry.
Bogota: Apartado Aereo 5431. Cable: ENESCODRIL. T. P. Whittaker, sales representative.

NATIONAL SUPPLY COMPANY OF VENEZUELA, C. A.
Suppliers and manufacturer of a complete line of drilling and production equipment, also tubulars for the oil and gas industry.
Caracas: Galipan, Planta Baja Oeste, Urb. El Rosal. Cable: ENESCODRIL, R. C. Allan, manager, L. L. Leigh, assistant manager.
Eastern District
Puerta La Cruz: Edo. Anzoategui. Cable: ENESCODRIL. J. M. Davies, district manager.
Anaco: R. L. Bowman, store manager. (Mail for Anaco should be sent to district address)
Barinas: R. S. Bernstein, store manager. (Mail for Barinas should be sent to Caracas)
Western District
Maracaibo: Edo Zulia, Hotel Del Lago. Cable: ENESCODRIL. F. H. Whiteside, district manager.
Las Morochas: R. J. Ritchie, sales engineer. (Mail for Las Morochas should be sent to district office)

DR. FERNANDO SARAVIA MARTIN

Area of Promise

An interview with

Fernando Saravia Martin

Director of Petroleum

Ministry of Development and Public Works

PERU's Director of Petroleum has an excellent technical background for his key post in the government's petroleum agency. Although Fernando Saravia Martin's degree is in civil engineering, he has had experience with an oil company and is highly respected in petroleum engineering circles.

Graduated in 1930 from the notable National School of Engineering, Dr. Saravia went into construction business on his own, an ambitious undertaking for one so young. When he became associated with the Compania Petrolera Lobitos in 1933 his task was to organize an engineering department for the British Company that operates in Peru. Later he was made head of the construction department.

He returned to business for himself after 8 years with Lobitos and plunged into the work of constructing highways, bridges, tunnels, buildings. One of his important works was the irrigation project on the Rio Tumbes.

In 1948 Dr. Saravia entered the government for the first time, becoming chief engineer for the Diverse Projects Section of the Commission for Distribution of Unemployment Funds. This is similar to a public works program. He served as chief of the technical section and as technical director of this agency before being appointed assistant administrative Director of Petroleum, Ministry of Development and Public Works, in 1953. The next year he was advanced to Director of Petroleum.

Not only does he handle an exacting and important office with ease and efficiency but he also keeps up with the professional phase of his career. He is a member of the Peruvian Society of Engineers and has served as director. He was a delegate of the Technical Group of Valuations to the First Inter-American Congress of Valuation.

In 1953 he was a delegate of the Peruvian government to the International Petroleum Exposition in Tulsa, Oklahoma, U.S.A. Those who met the Director then hope he will accept an invitation to the Exposition again when it meets in 1959.

Peru Trades Opportunity for Capital

THE LEGENDARY LAND OF THE INCAS IS ADVANCING SO RAPIDLY INTO THE MODERN WORLD THAT OIL CONSUMPTION IS OVERTAKING PRODUCTION . . . PRIVATELY OWNED COMPANIES GET A FAIR DEAL FROM THE GOVERNMENT IN THIS THIRD LARGEST OIL PRODUCING NATION IN SOUTH AMERICA . . . NEW LAWS FAVOR THOSE WHO FIND AND DEVELOP OIL RESOURCES, ESPECIALLY IN EASTERN ZONE.

Q. Which natural resources come under your department of the government?

A. The natural resources that are under the control of the Petroleum Division include petroleum, natural gas, natural asphalt and, in general, all analogous hydrocarbons in a solid, liquid, or gaseous state, or those that are found associated with petroleum. Helium gas and coal are excluded.

Q. Do you handle all phases of petroleum operations so far as the government is concerned?

A. The Petroleum Division as a state agency has in its charge the control and fiscalization of the petroleum industry in general. This control begins with the granting of permits for explorational studies and geological or geophysical prospecting made prior to a request for the granting of concessions, if the interested parties desire to make such preliminary studies. It is likewise the function of this Division to evaluate a company, prior to its registration, in regard to technical and economic qualifications prior to transmitting its request for concessions.

The Division controls and fiscalizes all works, whether in the exploratory or development stage, as well as activities in refining, manufacturing, transportation, and storage. Another important function of the Petroleum Division is the regulation of sales of combustibles on the internal market, establishing the production quotas for the different companies operating in the country, and fixing the prices of petroleum products in accord with the factors which intervene in their cost.

Q. How many are on your staff?

A. Presently, 77 people make up the Petroleum Division; this number includes the technical as well as administrative personnel. They are located in the Office of the Division, Agency of the Ministry of Development and Public Works, as well as in the Petroleum Inspection groups located in the exploration and development fields.

Q. Have any of these been educated in U.S. engineering schools or other engineering schools outside Peru?

A. Of the personnel in the Petroleum Division, 15 have the title of Engineer and all are graduates of Peruvian institutes, such as the National University of Engineering and the School of Engineering of the Catholic University of Lima. They all have had practical experience in the national oil fields. Some of them have taken specialized post-graduate courses in the oil fields of Venezuela and Argentina. None of them have received technical instruction in the U. S., but some have visited oil fields of the United States.

Q. Which colleges or universities in Peru give engineering and scientific degrees?

A. The National University of Engineering at Lima is the only institute of higher learning in Peru that graduates engineers specializing in petroleum, in a five-year course of study. The same school graduates Industrial Chemical Engineers which the petroleum industry employs. The National University of Engineering also graduates Civil, Mining, Mechanical, Electrical, and Architectural Engineers.

The School of Engineering of the National Catholic University grants degrees only in Civil Engineering. Outside of Lima are the Universities of Arequipa, Cuzco, and Trujillo. The University of Arequipa graduates competent geologists which are employed by the petroleum industry.

Q. I understand you have the oldest university in South America. Does it have a school of engineering?

A. The University of San Marcos, which is indeed the oldest university in America, dating from 1551, has a school of engineering which offers degrees only in Chemical Engineering. The university also offers the doctor's degree in geology, and has facilities of economic sciences and natural sciences.

Q. Do you consider the petroleum laws of Peru equally profitable to the government and to the private capital that is invested in oil?

A. The new petroleum law No. 11780 is without doubt equally beneficial for the government and the concessionaire in that it is based on a "50-50" participation in net profits. One condition specifies that a payment of 20 percent of the value of exports be made to the government in advance to the government's 50 percent participation in the profits.

As a benefit to the concessionaire, or private capital, a deduction from gross profits is permitted as a depletion allowance. In the Coastal area, this deduction amounts to 15 percent; in the Andean zone and in the Eastern area (Amazon Basin), the deduction is 27.5 percent.

Another of the advantages offered to the private investor is that there are no royalty payments. Under the old petroleum laws, royalties were paid in the amount of 10 percent in Coastal concessions and 4 percent in Eastern concessions. The new petroleum law also permits duty-free importation of equipment and material destined for use in exploration, exploitation, refining, and transportation.

Q. Do your petroleum laws favor Peruvian capital over outside capital?

A. The new petroleum law establishes no privileges for national investors over foreign investors. As far as rights and obligations are concerned, the only exception that exists is that, in the Coastal area, the Peruvian investor is permitted a deduction of 25 percent as a depletion allowance compared to the 15 percent deduction allowed to the foreign investor. This is not so much a situation of privilege as it is a method of security for national capital. In effect, while the large petroleum companies dedicate part of their profits to exploration, national capital in our country must operate with the funds of its own social capital, thereby necessitating the compensation in the petroleum laws.

Outside of this aspect, the only other disposition to be cited is that only national companies may solicit concessions within a belt of 50 kilometers from national borders. This disposition is simply one of national security and does not constitute a privilege. This ruling has long been found in our national constitution, prior to petroleum law No. 11780.

Corporations organized for petroleum exploitation are considered to be national organizations when at least 60 percent of the capital is invested by native Peruvians, leaving 40 percent which can be covered by foreign investors.

It is determined by law that companies which organize in Peru with foreign capital must offer 30 percent of their shares to national capital for a predetermined period. If at the end of this time the 30 percent has not been subscribed, all of the capital of the companies can be from foreign investors.

The New ... Ministry of Education building in Lima. The capital of Peru is dotted with modern buildings along with some fine examples of colonial architecture.

Q. Have recent changes in the petroleum laws increased oil activities?

A. With the passage of the petroleum law No. 11780, activities have increased greatly and to the benefit of the country. Before the year 1952 when the law was passed, there were only four companies operating in the country. With the advent of the new law, many new companies began to enter Peru. At the end of 1957, the operating companies totaled 16, to which the government has granted a total of 16,300,000 hectares in the Coastal area and in the Eastern zone.

Q. I understand the new depletion allowance has increased investment in Peruvian oil. Will you explain this?

A. Without doubt the introduction of the depletion allowance in the new petroleum law has created a favorable climate for petroleum investments. Such a deduction was not included in the old petroleum laws 4452 and 8527, although the mining industry was granted a deduction under law 7904. But with law No. 11780, investors have the necessary inducement to solicit concessions and to exploit and develop the fields granted to them, resulting in the entrance of the many new companies to the country. This inducement is also reflected in the many acres of concessions granted.

Q. What amount comes to the government from the petroleum industry annually?

A. During 1956, the Peruvian government received from the four companies operating in the country a total of S/o. 357,918,912. The four companies were International Petroleum Company, Compania Petrolera Lobitos, Empresa Petrolera Fiscal, and Compania de Petroleo Ganso Azul, Ltda.

Q. What percentage is this of the total government budget?

And the Old . . . One of the archaeological finds of the world is the discovery of Machu Picchu, high in the Andes. This "Lost City of the Incas" was discovered in 1912.

A. In relation to total income for the national budget, the sum derived to the present from the petroleum industry constitutes approximately 12 percent of the income.

Q. What other industries provide greater sums for government requirements?

A. Since Peru is essentially an agricultural and mineral-producing country, the government obtains its greatest income from cotton and sugar as well as the exportation of minerals.

Q. Are your people benefited by operations of oil companies?

A. The social benefits derived from the petroleum industry are indisputable. In addition to the direct fiscal benefits, the oil companies provide employment for a large sector of the population, either directly in their fields or indirectly, such as the persons or businesses engaged in the distribution of combustible products. Likewise, the manufacturing and transportation industries have had great opportunities for expansion, thanks to the distribution of fuels for the needs of the internal market.

Q. Do they, themselves, feel that oil operations are good for the country?

A. In our country, the necessity and worth of exploration and development are recognized, not only for the direct fiscal benefits but also for the availability of fuels so necessary to the development of the country.

Q. Have oil companies helped in any way to educate more engineers and scientists?

A. A great number of professionals who have been graduated from national institutes and who are employed by the oil companies have been sent to the exterior—especially to the United States — to pursue advanced studies in their particular fields. Also, the oil companies offer all cooperation with the technical students wishing to gain practical experience in the fields.

Q. By law, what percentage of Peruvians make up personnel in an oil company?

A. Law No. 7505 established that the employment of national personnel should be no lower than 80 percent, and also regulated the amount of their wages and salaries. Article 119 of the new petroleum law No. 11780 and Article 256 of the Regulations deal with the preference that should be shown to national personnel, but leaves the question of ranking to the judgment of the employing company.

Q. How many are employed by the petroleum industry?

A. In 1957, the oil companies had in their fields, refineries, and auxiliary services a total of approximately 9000 employees and workers.

Q. Have you established any Peruvian research organizations or do you have plans for any?

A. We have personnel apt and capable to enter the field of scientific research, but the lack of economic resources has been, in the most part, the principal obstacle to the creation of an institute for true scientific research.

Q. What is your present oil export-import picture? What has been the change in consumption of oil products in Peru in the past few years?

A. The rapid industrial expansion observed in Peru after the last war caused a considerable increase in the internal consumption of petroleum products. Since domestic production did not keep pace with the increased needs of internal market, exports were forced to drop. What's more, since domestic production still could not satisfy the domestic demands for heavy fuel oils it was necessary to begin importation. This began in the last quarter of 1954 with a volume of 424,146 bbl and in 1956 had reached a total of 1,414,899 bbl.

The following table shows the balance of petroleum movement, but does not consider oil in stock.

Year	Total production bbl	Domestic consumption bbl	Exports bbl	Imports bbl
1940	13,105,931	3,572,646	9,021,886	.....
1945	14,827,018	5,167,752	9,499,858	.....
1950	16,126,383	8,248,653	8,384,307	.....
1955	18,332,995	13,345,059	7,185,120	1,255,227
1956	19,510,313	14,229,940	7,859,595	1,414,899

This table readily shows the rapid advances made in domestic consumption. In a period of 16 years (1940-1956), domestic demand has quadrupled while production has realized relatively slow advance.

Q. What do you predict for the future?

A. It is expected that the future years will see a quickening of the petroleum industry, spurred by the large areas under exploration in the Eastern zone where first successes are presently being scored by the Compania Peruana de Petroleo "El Oriente" with the discovery in the Maquia wells of commercial production from a vast structure.

With the knowledge obtained in drilling the Maquia wells and the wells in the Aguas Calientes field, the future for the petroleum industry in the Eastern zone is assured. It is further expected that, in the 14,500,000 hectares of concessions granted to the major oil companies in this zone, more such successes will be repeated. Then production will be sufficient to justify the installation of a pipeline to carry the oil to the Peruvian Coast. This will satisfy the industrial development of the country at the same time that it fills the need for crude oil all along the Pacific Coast of South America. * * *

Green Hell. A tug pulls one of the houseboats that makes up Texaco's river-town on the Marañon. This river has risen 16 ft within a short time, putting a stop to drilling operations. So far three wildcats were drilled along the river. Transportation in the jungle limits operations. — Texaco.

PERU PREPARES for FUTURE

Ernestine Adams

IN THE VALLEYS of jungle rivers of Peru grows the "Tree of Life." Its fruit is food that can be eaten raw or cooked; from its sap comes milk, from its trunk comes sugar; its seeds are a coffee substitute.

From the "Tree of Life" or, if you will be practical — the Carnauba palm —are extracted candle wax, polish, varnish, starch, baskets, rope, lumber, and even medicine.

With this bonanza tree you wouldn't think that the 10 million people in Peru would have much need of petroleum but they do. Peruvian demand for the liquid energy has increased much more rapidly than the nation's production. In 1950 consumption was 50 percent of output; today consumption is about 75 percent of production.

One reason for rising demand is that the Peruvian government sets the price of products in the nation and currently regular gasoline costs about 10 cents (U. S.) a gallon. The price is very low even for Peru with its virtually free exchange and low prices. About one third of this is tax, of which a large part goes into building new highways.

Before a producer can export crude oil he must supply, in proportion to his output, sufficient petroleum products to satisfy internal demand. So the oil operator, making little profit on internal business, has to depend on exports of crude oil for his earnings.

If you are worried about U. S. imports, Peru is one oil-producing nation that buys more oil products from the U. S. than the amount of crude oil she sells in this country. In 1956 the U. S. imported 522,000 bbl of crude oil from Peru, and sold her 645,000 bbl of oil products, mostly aviation gasoline.

Peruvian laws for oil exploration and development are presently among the fairest in any country where the government owns all subsurface rights, as Director Fernando Saravia Martin points out in the preceding pages. His claim is proved by the number of companies (see Table 1) now diligently exploring the Oriente Zone, a costly and difficult operation.

The Green Hell

The tropical green jungle, crossed by rivers that rise 15 ft without warning, is the most promising region for oil. It is in this rain-catching jungle of the East, bigger than Texas, where the latest field was discovered near Contamana by the Peruvian company known as Cia. Peruana de Petroleo "El Oriente," and three West German firms. Jersey Standard has a small interest in one of the West Germany oil companies.

Only 13 percent of the entire population, including headhunters, live in the Montanas; there are more alligators, jaguars, anacondas, and macaws than people. A Texaco exploration party in the Ucayali Valley killed a 20-ft anaconda last fall that had just swallowed a 6-ft alligator. These aquatic boas have been found as long as 30 ft.

The jungle capital is Iquitos on the left bank of the Amazon, a city of 60,000. Rubber, alligator skins, and a brown cotton are moved 2500 miles from Iquitos to the mouth of the Amazon River on the Atlantic for export.

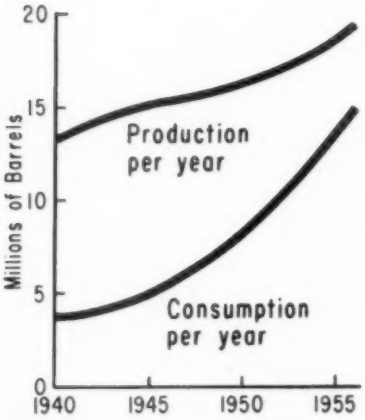
Besides the new discovery there is one other oil field in the Montanas. The Aqua Caliente field (owned by Cia. de Petroleo Ganso Azul*) was discovered

Miss Adams is Management Editor. She visited South American countries last fall and covered those considered the most promising areas for outside capital in the oil industry.

*Transportes Amazonicos, the holding company for Cia. de Petroleo Ganso Azul, operators of field, is 76 percent owned by Texas Gulf Producing Company, Houston, Texas.

White Heights. Snow-topped peaks of the Andes form a wall between the vast green jungle and the Pacific Coast. They will make a rugged crossing for a pipeline from the Oriente. Oil men believe production would have to be 100,000 bbl a day to make such a pipeline economical. — *Braniff Airways.*

OIL COMPANIES HOLD CONCESSIONS OVER SOME 33 MILLION ACRES — MORE THAN ANY OTHER LATIN AMERICAN NATION . . . CONSUMPTION WILL SOON OVERTAKE PRODUCTION IF MORE RESERVES ARE NOT FOUND . . . EXPLORERS HAVE GREAT HOPES FOR NEW PRODUCING AREAS IN THE JUNGLES OF THE ORIENTE . . .



Peru's Supply and Demand. The narrowing margin between production and consumption is one reason oil explorers are welcomed in Peru. The nation wants to remain in the list of three (Venezuela, Colombia, Peru) that do not have to buy oil supplies.

in 1938. The first well was drilled by J. E. Brantley, veteran U. S. drilling contractor, and the site was selected by Douglas Fyfe, another U. S. oil man. (See Petroleum Profile, page A-8). It developed slowly because of limitations of local markets.

In 1955 a 45-mile 4-in. pipeline with 4500 bbl per day capacity was built to Pucallpa on the Ucayali River. A small topping plant (500 bbl a day) at Pucallpa takes care of the local needs. Remainder of the 2200 bbl per day now being produced goes on barges down the Ucayali to Iquitos where a 1200 bbl per day plant of Empresa Petrolera Fiscal, the state-owned company, processes for the markets there. Any crude not used at these two refineries is freighted down the Amazon River to Manaus, Brazil, where a 5000 bbl per day refinery was completed in 1956. So three small plants depend largely upon the Aqua Caliente field, a petroleum oasis in a green jungle.

Another project in this same region is a colonization enterprise of R. G. LeTourneau, the heavy machinery manufacturer, who in return for some one million acres of land, is constructing highways — one near Pucallpa and the Ganso Azul field.

Explorers in the green forest sea of the Eastern Zone travel by water and drill by the side of erratic rivers that flood and recede unpredictably.

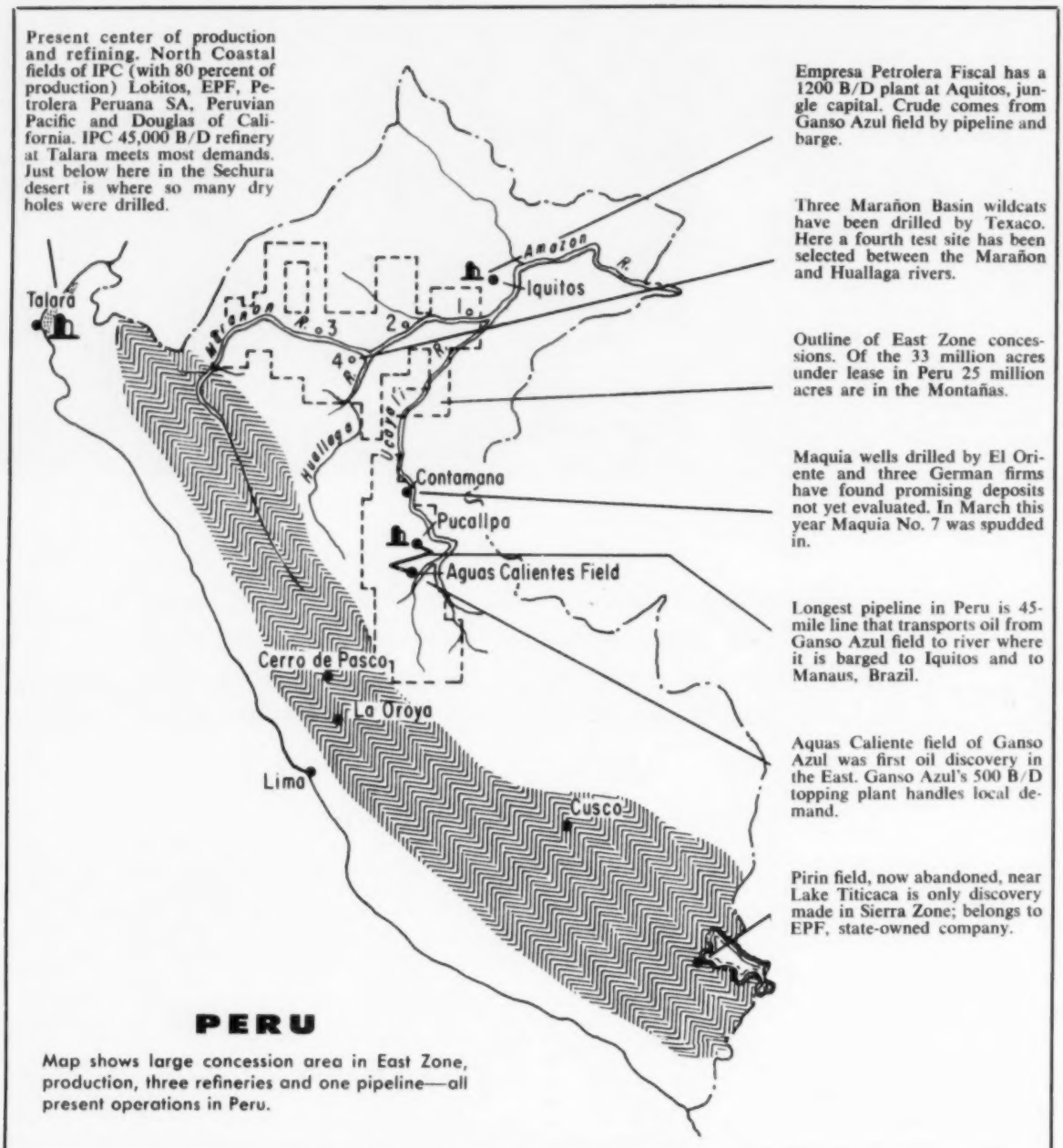
The Texas Petroleum Company took an active part in exploration in the Oriente when it acquired nearly five million acres after the favorable law of 1952 was passed. It has drilled three stratigraphic tests along the Marañon River.

Logistics presents a formidable barrier to operations in the jungle. Santa Fe Drilling Company, which has contracts to drill the Texaco tests, sent a light rig from Houston on a converted LSM to the East Coast of Brazil and up the Amazon River to Iquitos. The trip took 49 days.

At Texaco drilling operations (the fourth test is to be on a concession previously held by "El Oriente" between the Marañon and Huallaga rivers) the crew lives in a floating river-town that contains an infirmary, kitchens, fresh water supply, an office, sleeping quarters and recreation rooms. Twice weekly a flying boat brings mail and supplies.*

Heavy rains (average 300 in. annu-

*See "Houseboat on the Marañon," *Texaco Star*, Spring 1957; Ellis Prudden, Editor.


Present center of production and refining. North Coastal fields of IPC (with 80 percent of production) Lobitos, EPF, Petrolera Peruana SA, Peruvian Pacific and Douglas of California. IPC 45,000 B/D refinery at Talara meets most demands. Just below here in the Sechura desert is where so many dry holes were drilled.
Empresa Petrolera Fiscal has a 1200 B/D plant at Aquitos, jungle capital. Crude comes from Ganso Azul field by pipeline and barge.
Three Marañon Basin wildcats have been drilled by Texaco. Here a fourth test site has been selected between the Marañon and Huallaga rivers.
Outline of East Zone concessions. Of the 33 million acres under lease in Peru 25 million acres are in the Montañas.
Maquia wells drilled by El Oriente and three German firms have found promising deposits not yet evaluated. In March this year Maquia No. 7 was spudded in.
Longest pipeline in Peru is 45-mile line that transports oil from Ganso Azul field to river where it is barged to Iquitos and to Manaus, Brazil.
Aquas Caliente field of Ganso Azul was first oil discovery in the East. Ganso Azul's 500 B/D topping plant handles local demand.
Pirin field, now abandoned, near Lake Titicaca is only discovery made in Sierra Zone; belongs to EPF, state-owned company.
Talara
Iquitos
Amazon R.
Marañon R.
Huallaga R.
Ucayali R.
Contamana
Pucallpa
Aguas Calientes Field
Cerro de Pasco
La Oroya
Lima
Cusco
PERU
Map shows large concession area in East Zone, production, three refineries and one pipeline—all present operations in Peru.

ally) often cause floods that halt operations. At best the Marañon is swift and roiling. Rains have swelled the river to 16 ft above normal and drilling must give way to the demanding natural hazards of the "Green Hell" of the Oriente.

Peruvian Pacific Petroleum Company (Cities Service) and Richfield continued joint exploration in the East. Their airborne magnetometer survey was completed recently.

Peruvian Gulf Oil Company is doing geological field work and aerial photography. As a result of magnetometer data compiled by Fairchild Aerial Surveys in 1956 Peruvian Gulf retained some 1.7 million acres of its Eastern concessions.

During the past four years Mobil Oil Company del Peru, a Socony Mobil affiliate, has had two geological parties in the field and has participated in aerial photography, air magnetic and reconnaissance seismic surveys.

Early in 1958, Mobil began seismic evaluation of several anomalies mapped by surface parties on its concessions midway between the Ganso Azul and Maquia fields. Company spokesmen anticipate that this work will lead to drillable locations in this area. Mobil holds some three million acres in various parts of the Montanas.

The White Heights

West of the watching jungle the Andes rise to glacier-capped peaks, highest mountains in the world outside the Himalayas. Even the passes through the Andes are high and regularly blocked with snow.

Here in the high plateaus—the Sierra Zone — the Incas built a network of roads and beautiful walled cities, creat-

ing one of the greatest empires the world has ever known.

Today in the Sierra Zone such companies as the Cerro de Pasco Corporation‡ work their mines for zinc, lead, copper, silver, and gold; produce bismuth, antimony, arsenic, and many other minerals. In 1956 Cerro de Pasco spent $80 million to expand its La Oroya copper smelter.

Once early this century oil was found in the Andes near Lake Titicaca, at 12,000-ft elevation the highest navigable lake in the world. Pirin field yielded some two to three hundred thousand barrels of oil and was later abandoned. Only one concession is held in the Sierra Zone today. (See Table 1.)

The secret green jungle and the towering white mountains are glamorous and awesome. They present, however, constant irritants to human comfort. It is said that when the "Unique Inca" moved a conquered tribe in his empire he sought the same elevation as the home they were forced to leave. These early peoples clearly recognized the problems of elevation in Peru.

Coastal Zone

The coast is a desert, amazingly fertile and laced with scores of rivers and creeks that flow from the Andes to the Pacific. Along this narrow rainfree coast fertile land grows cotton, sugar cane, rice, and grapes for the famed Pisco brandy.

In the Northwest Coast are the largest oil reserves and the Talara refinery of International Petroleum Company, an affiliate of Jersey Standard, which dominates Peruvian oil business.

Of the 19 million bbl output in Peru last year IPC produced nearly 13 million bbl, and Cia. Petrolera Lobitos, a British firm, 4 million. Empresa Petrolera Fiscal (government company), Cia. de Petroleo Ganso Azul, Petrolera Peruana, (local company), and Douglas Oil of California have smaller production. All except the Ganso Azul field output is from the North Coast region.

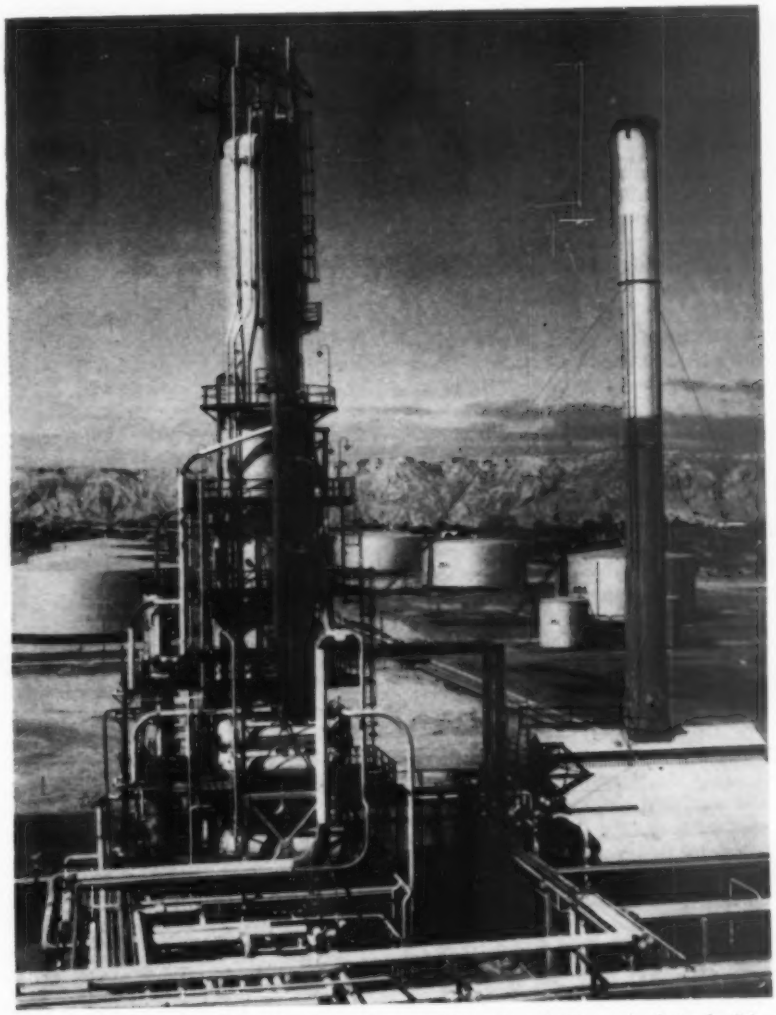
In this area, too, is the Zorritos field, discovered about 1860 and producing ever since, making it one of the oldest fields in the world.

International Petroleum began operating the large La Brea and Parinas area in 1914 under lease from the London and Pacific Petroleum Company. Oil had been discovered there in 1888. IPC acquired title from the Keswich and Tweedle families who then owned it, in 1924.

When IPC leased La Brea Parinas

‡This is largest single company in Peru. It was organized in 1902 by J. Pierpont Morgan, Henry C. Frick and other U. S. financiers. Mines, smelters, one of the highest railroads in the world, are among its assets. More recently the management (Robert P. Koenig, president) has turned its attention to oil.

Empire Capital. High in the Andes is the ancient city of Cusco, once the hub of the Inca Empire. Spanish conquerors built cathedrals on the foundation of temples to the sun.
— Braniff Airways.



Products for Peru. On the northwest coast are Peru's largest production and refining facilities. Here is the new pipe still at International Petroleum's refinery in Talara. It has a capacity of 45,000 bbl of crude a day.
— Jersey Standard.

oil field there was a 3400 bbl a day skimming plant at Talara. The plant has been modernized and expanded until today its 45,000 bbl a day capacity supplies most of the Peruvian demand and some products are exported, mostly to South and Central American countries.

Douglas Oil Company of California holds an offshore concession adjacent to the Lobitos land concession. Peru claims jurisdiction over 200 miles of seabed and surface water.

One of the biggest drilling failures in South America was the Sechura desert operation. It is hard now to pin down the reason for such a big drilling program in the area south of the North Coast producing region.

Perhaps the new petroleum law that gave an oil company a chance to manage its own business sparked the operations. At any rate, no sooner was the law passed in 1952 than the Sechura was blanketed by applications. Many U. S. companies entered the country for the first time, new Peruvian companies were organized, West Germans came on the scene. Everyone wanted to drill the Sechura. And they did.

Millions of dollars poured into the desert exploration produced only a crop of dry holes. Some geologists say we already knew there was no oil in Sechura; others will tell you oil is there and some companies continue to look.

As you in the industry know, either can be right.

History and Politics

It would be hard to choose the most fascinating side of Peru. Her geography encompasses almost every kind of region and climate. Her civilizations before the Spaniards came draw archeologists like a magnet. About the time of Christ the first American civilization of big cities and skilled workers grew up in Peru. It fell into decline after 900 years or so and was replaced in the 12th century by the rise of the Inca Empire.

Ruins at Cusco, "City of the Sun," capital of the Inca Empire, and Machu Picchu, "Lost City of the Incas," indicate a high civilization, with strong administration and welfare organizations, well developed architectural, engineering and legal knowledge, military skill, and an advanced culture of arts and science.

The Incas were conquered by Francisco Pizarro, who would be a good subject for a "Golden Years" theme. He is believed to have been nearly 70 years old when he invaded Peru with 177 men and brought it under the rule of Spain. He treacherously had Atahualpa, Inca ruler, killed and subdued his empire in 1533. Two years later he founded Lima, "City of Kings," and there was murdered in his own home by others who were ambitious, too.

Lima became one of the most magnificent colonial cities in history* and remains today one of the loveliest in the world.

Peru is partially indebted to an Irishman for its independence. Ambrose O'Higgins came to South America as a peddler and rose to Viceroyalty. His son, Bernardo, fired by American and French revolutions, became Liberator of Chile and raised the army that another hero, San Martin, led against Lima. San Martin joined forces with Simon Bolivar to gain the independence that was proclaimed July 28, 1821.

Recent politics has been similar to those in other Latin American coun-

TABLE 1. PETROLEUM CONCESSIONS IN PERU

Petroleum Concessions Granted Under Provisions of Laws No. 11780 and No. 12376. (Status as of December 30, 1957.)

(Table supplied by C. N. Griffis)

NORTHERN COASTAL ZONE	Explor. hectares*	Exploit. hectares*		Totals in hectares*
Petróleo Sullana Ltd. (1)	—	22,841		22,841
Petrólera Peruana S.A.	8,068	—		8,068
International Petroleum Co., Ltd.	29,465	—		29,465
Peruvian Gulf Oil Co.	18,000	—		18,000
Texas Petroleum Co.	—	38,915		38,915
Peruvian Pacific Petroleum Co. (3)	567	—		567
Trans-Western del Peru S.A.	1,610	—		1,610
	57,711	61,756		119,467
CONTINENTAL SHELF ZONE (North)				
Petrolera del Pacifico S.A.	—	10,442		10,442
Petróleo Sullana, Ltd.	18,550	—		18,550
Petróleo Peruana S.A.	25,025	—		25,025
	43,575	10,442		54,017
SIERRA ZONE				
Augusto F. Wiese	4,000	—		4,000
	LAW 11780		LAW 12376	
ORIENTE ZONE OR EASTERN PERU	Explor.	Exploit.	Explor.	
Peruvian Oils and Minerals, Ltd. (4)	703,477	42,250	—	745,727
Cia. Peruana de Petróleo "El Oriente" S.A.	992,989	—	172,000	1,164,989
Cia. de Petróleo Ganso Azul, Ltd. (4)	333,537	14,723	—	348,261
Texas Petroleum Co.	670,645	—	999,996	1,670,642
Mobile Oil Co. of Peru	1,000,000	—	213,259	1,213,259
Peruvian Pacific Petroleum Co. (3)	1,000,000	—	389,982	1,389,982
Richmond Oil Co. (2)	443,337	—	100,000	543,337
Petróleo Sullana Ltd. (1)	1,000,000	—	—	1,000,000
Corp. LeTourneau del Peru Inc.	115,394	—	—	115,394
Peruvian Gulf Oil Co.	704,800	—	—	704,800
Cerro de Pasco Corp.	856,153	—	141,334	997,487
Trans-Western del Peru S.A.	734,788	—	—	734,788
International Petroleum Co. Ltd.	1,000,000	—	1,000,000	2,000,000
Petrolera Peruana S.A.	206,648	—	—	206,648
German group (6)	100,000	—	—	100,000
Skiles Oil Corp.	199,818	—	—	199,818
	10,061,592	56,973	3,016,572	13,135,137

RESUME

ZONE	LAW 11780 Explor.	LAW 11780 Exploit.	LAW 12376 Explor.	
North Coastal Zone	57,711	61,756	—	119,467
Continental Shelf (North)	43,575	10,442	—	54,017
Sierra Zone	4,000	—	—	4,000
Oriente or Eastern Zone	10,061,592	56,973	3,016,572	13,135,137
TOTALS	10,166,878	129,172	3,016,572	13,312,623

[1]Petrolera Sullana Limitada is held 60% by the Wiese interests of Lima and 40% by the Union Oil Company of California.
[2]Richmond Oil Company is a subsidiary of the Standard Oil Company of California.
[3]Peruvian Pacific Petroleum Company is a subsidiary of Cities Service Company of New York.
[4]Peruvian Oils & Minerals, Limited has transferred to the Compania de Petroleo Ganso Azul, Limitada 66⅔% of its shares in a total of 77,640.55 hectares of its exploration holdings in the Oriente or Eastern Peru.
[5]Texaco previously held 1,000,000 hectares under Law 11780, but relinquished 329,324 hectares to take over a two-thirds interest in Petrolera Yurimaguas. The latter company holding 488,789 hectares has been formed on the basis of certain concessions previously held by Cia. Peruana de Petróleo "El Oriente" S.A.
[6]The German group comprises the following major companies in West Germany: — Gewerkschaft Elwerath, Deutche Erdöel Aktiengesellschaft, and Wintershall Aktiengesellschaft.
*1 Hectare = 2.4711 acres.

†The Pulitzer prize novel, "The Bridge of San Luis Rey" by Thornton Wilder is set in colonial Lima and one of the characters is the famous actress Perricholi, who is still talked about in Lima. The villa where she lived as the Mistress of Count de Amat, the king of Spain's viceroy, is one of Peru's fascinating museums.

City of Kings. Broad plazas and fine Colonial architecture make Lima one of the fairest cities in the world. The U.S. Embassy is in the "Sud America" building across the plaza. Plans have been approved for a U.S. Embassy building to be constructed in Lima. — *Peruvian Times.*

tries but a native Peruvian will tell you convincingly that his country is more stable politically than others.

It is true that Peru went to the polls June 17, 1956, and held a free and contested election; it is also true that this was the first in more than a decade. In this election women were allowed to vote for the first time.

Voters elected Dr. Manuel Prado Ugarteche as president, a conservative, who is making every effort to establish and preserve a healthy economic climate for private business and industry.

Like many heads of state Dr. Prado inherited a number of liabilities. The state treasury had been stretched too thin in order to promote public works. Costly buildings left little money for maintenance and operation. Social legislation has grown too broad for practical application. Needs are great but the best plans disintegrate if they are too far removed from execution.

A Capitalistic Economy

On the other hand, because private enterprise is the basis of its economy Peru has attracted outside capital which has helped to find new resources and develop them. Modern towns have been built by IPC and Cerro de Pasco and other concerns.

Peru was among the first to cast off controls on business after World War II. In the years between 1949 to 1955 the national production doubled. At present the situation is a little rocky but the foundation for solid advance is still in place.

In the first half of 1957 U. S. exports rose 36 percent to $100 million while U. S. imports from Peru showed a decline in the first five months of last year to $56 million, mostly cotton and sugar. This unfavorable trade balance has not helped the government deficit; the decline in copper, lead and zinc prices has cut foreign exchange earnings.

U. S.-Peruvian relations have been friendly in the past and growth of communications has tied the two nations closer together.

Raul Deustua, writer and editor, once wrote: "For the average North American — if there is such a person — Peru is a name on the map, a southern neighbor whose borders are only vaguely defined in his mind, with coasts on the Atlantic or the Pacific. . . ."

We'll agree the average North American isn't too clear about his geography, in the U. S. or outside, but regular airline service with direct flights and improved shipping schedules have aided mutual knowledge. Business men and tourists fortunate enough to travel to Peru proclaim its charm and are enthusiastic about its opportunities. The enterpriser works for a profit and here is a nation that permits a profit.

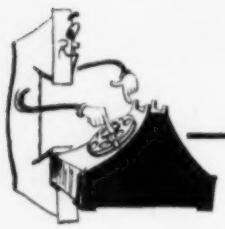
Future for Oil

The outlook for oil operations depends largely on successful exploration of the Oriente. IPC is developing efficiently its large holdings on the Northwest Coast using secondary recovery projects and improved lift methods. This operation includes now a half interest in Cia Petrolera Lobitos' adjacent 136,000-acre concessions, for which IPC paid $15 million in 1957. It is committed to spend $40 million over a period of five years to operate and develop the concessions. Lobitos will contribute its 50 percent share.

Peru has the largest areas covered by oil concessions of any Latin American country — nearly 33 million acres. Table 1 shows that the concessions are held by many companies. Laws and regulations are equitable. There is strong indication that Peru will be subject to one of the most thorough oil searches ever undertaken in one country.

Activity will be centered in the Oriente. Development of enough reserves for an Andean pipeline to the Pacific will be the hope of those seeking oil in the great basin walled in by the Andes. That means a goal of 200 million bbl of reserves and 100,000 bbl a day production. You'd have a hard time setting a date to reach the goal but at least the project is already begun.

★ ★ ★



ARE YOU PHONOGENIC?

Get a Line on Yourself

HAVE YOU EVER stopped to take stock of your telephone habits? Have you ever given any consideration to the way you answer the phone?

There is a whole new world of emphasis being placed on telephone techniques these days. Business executives everywhere recognize the importance of good telephone habits.

You can be one of the top public relations people in your company. When someone calls on the telephone, as far as he's concerned you are the company. When you talk, it's the company talking. And if you sound cheerful, clear, and interested, his attitude toward your company will be a good one.

More personally, your telephone manners are important because many of us meet more people every day over the phone than face-to-face. The person on the other end of your telephone may never see you and yet know you well. Your voice and mouthpiece manners give the clues.

To get a line on how you rate, phonogenically speaking, try this quiz.

(1) Do you answer the phone promptly? Yes—— No——

Grab that phone!

Nobody likes to be kept waiting, especially on the telephone. So answer yours promptly. If you can't, explain the delay and apologize for it. Your caller may have good news or an important message for you, and he may not have time to wait.

(2) Are you easy to trace? Yes—— No——

When you leave your office for any length of time, don't keep your absence a secret. Someone may call for information which only you can give. Let it be known where you can be reached, how long you'll be there, and when you'll be back. That way, if someone calls, whoever answers the phone won't have to go on an office-to-office manhunt. Time is money, so when you leave, leave word.

Be easy to trace

(3) Is your telephone voice good?

If you were to phone yourself, you'd find that your voice had four important characteristics: cheerfulness, distinctness, loudness, and speed.

See yourself as others hear you

(4) Are you cheerful? Yes—— No——

It'll make your caller feel good, and you'll feel better, too, if you're cheerful. Get that "glad to hear from you" ring in your voice, you'll find callers becoming just as sweet as can be.

(5) Do you talk normally? Yes—— No——

Some people try to change their personality when they pick up a receiver. Some roar like a bull moose paging its mate. Others whisper as though their message were a deep dark secret. Still others try to sound sophisticated . . . or mechanical . . . or cute . . . or like a big shot. But did you ever notice how real big shots talk? They're as clear and as simple as can be.

(6) Do you tell the world who you are? Yes—— No——

If you want to save time, and sound business-like, too, tell your caller right off the bat who you are. "Natural gasoline department, Sam Snow speaking," sounds efficient as well as saving your time and your caller's. "Yes" or "Hello" mean nothing. If you answer someone else's phone, "Mr. Jones's office, Miss Brown speaking," makes everything clear.

(7) Do you kick a caller around? **Yes—— No——**

Don't kick a caller around.

Nothing is more irritating than "the telephone runaround" — being kicked from one extension to another. When you get a call, handle it if you can. If you can't, tell the caller you'll transfer him to the right party. Then do it — with all the promptness and care you would expect from someone else. It's worthwhile treating all calls as important. Most of them are!

(8) Do you find out who? **Yes—— No——**

Find out whooo

If you answer someone else's phone, and the caller doesn't identify himself, try to find out tactfully who he is. Don't, of course, bark, "Who are you?" He may be the president, and you'll find out! A better way is, "May I have him call you?" And don't put down the telephone until you're sure the conversation is over . . . the caller may want to talk to someone else.

(9) Do you answer your own phone? **Yes—— No——**

If you're in the executive category and have a secretary, do you charge her with answering your phone, or do you answer it yourself? It makes for better relations to answer it yourself.

(10) Does your phone have snap, crackle, and pop? **Yes—— No——**

You wouldn't think of slamming the door when a visitor leaves your home. Give your telephone caller the same courtesy. At the end of the call, hang up gently. Don't bang the receiver so your caller gets a sharp crack in his ear. Next time he may get even.

(11) Do you trust to memory? **Yes—— No——**

Don't trust to memory

If there's a message, write it down. Even if there's no message, make a note of who called and at what time. If the caller would like his call returned, be sure to get his name and number accurately. Your handling of telephone messages is a mark of your efficiency.

(12) Do you spend too much time on the phone? **Yes—— No——**

There is always the chance that the person you are calling (or who is calling you) may be very busy. So to save your time and his, identify yourself quickly and state your business. Be cordial, but be informative and business-like.

(13) Do you interrupt personal visitors to take telephone calls? **Yes—— No——**

Nothing is more boring for your visitor than to listen to a one-sided conversation. Ask your party if you can't call back later.

(14) Do you place calls through your secretary or the operators and then keep the party called waiting? **Yes—— No——**

Always be ready to talk before you make the call. Time is important to everyone.

Reprinted from *The Relic*, Reserve Life Insurance Company magazine; Mayfair Macaulay, editor.

HOW DO YOU RATE?

Score yourself 10 points for "Yes" answers to questions 1, 2, 3, 4, 5, 6, 8, and 9, and "No" answers to questions 7, 10, 11, 12, 13, and 14.

Locate yourself on the sliding scale:

120-140 — Stick around, you'll go far.

80-110 — A little improvement is necessary.

40-70 — Read this quiz again and again.

0-30 — Don't answer that phone.

If you are guilty of any of these errors, you may be cutting down on your personal efficiency, hurting your own business reputation, hurting your company's public relations, and setting a bad example for your co-workers.

You Can Study

Petroleum Engineering Abroad

Not only has U. S. education developed and expanded in this field . . . Foreign universities have established technological courses for future oil men

Harry H. Power

CURRICULA in petroleum production engineering abroad have been in existence for a comparatively short time.* Need for such instruction has not been great up to now. Increasing activity in oil production, world-wide, has stimulated the demand for educational programs in the more prominent technical institutions. A few typical programs will be described.

University at Delft

Program of the Department of Mining Engineering covers a period of five years, although only students of exceptional ability complete their work in the prescribed time. The average student requires at least one year longer.[1]

During the first year, all students receive instruction in the same courses. In the final two years, the program is built around a chosen option, such as mining (coal or ore), petroleum engineering, geology, metallurgy and geophysics. All six programs lead to the degree of Mining Engineer.

The curricula emphasize complete fundamentals of mathematics, physics, chemistry, thermodynamics and geology. General engineering courses in strength of materials, mechanical engineering, surveying, electricity and metallurgy are offered in addition to the departmental courses in mining and metallurgy.

Courses in social legislation, mining laws, constitutional law, economics and industrial management are characteristic of all options. Specialized courses in the particular option chosen and compulsory participation in research or investigational colloquy complete the program.

As a general observation, instruction by the well qualified staff members is thorough. As the students advance through the secondary schools and the technical university, the process of elimination by examination attains the end result of competence and professional bearing.

Perhaps a part of the favorable results can also be attributed to encouragement of students to master individually the assignments received in class. Self-reliance is attained early, which manifests itself later in practice. Relatively small classes also serve to attain these goals.

The Dalton System

In 1933, the Dalton plan [2] for teaching in the secondary (H.B.S.) schools was founded at the Hague, Netherlands. This system, originating in the United States, places greater emphasis on the individual, who is at liberty to elect any subject, select any classroom, or consult any teacher.

The one important restriction is that the assignment made by the student must be completed within the prescribed time. At the end of the five-year course, the Dalton student must submit to the same final examination as any other student completing his secondary education.

Contact and cooperation with fellow students and a closer relationship with teachers are emphasized. Too, the budgeting of one's time and the wise use of one's freedom are items of great importance in the student's attitude and preparation for his life's work.

With respect to higher education, the secondary school examines its students and thereby determines which ones shall gain entrance to higher institutions of learning.

Processes of free choice and selectivity exercised by and on students from the early 'teen' ages onwards, have influenced greatly the aptitudes and proficiencies of the final end-products in higher education and professional life in Holland.

French Institute

Prospecting activities in France, the French Union and Iraq subsequent to World War II presented new problems at the time of the industrial expansion of the country. The French Institute of Petroleum, Fuels and Lubricants (Institut Francais du Petrole des Carburants et Lubrifiants) was established during the reconstruction period and its professional character was defined in the law of November 17, 1943. The three missions entrusted to the Institute are: [3]

1. "Initiation or execution of studies and research presenting an interest for the development in France of scientific knowledge and of industrial techniques;
2. "Formation of engineers and foremen capable of participating in development, diffusion and effective application of new ideas;
3. "Documentation of government, industry and technicians themselves on new scientific knowledge and industrial techniques of interest to the national economy."

In short, its mission "is to bring to a maximum the scientific and technical activity of industrial enterprise, rather than carry out such activity outside the sphere of industry and in its place.

One of the schools under the charge of the Institute is the National Advanced School of Petroleum *(Ecole Nationale Supérieure du Pétrole)*. It was created in 1924 at the University of Strasbourg. Since 1947 it has functioned within the framework of the French Petroleum Institute at Rueil-Maimaison and offers courses of particular use in industry.

While the students engage in creative work and research, the staff includes

Dr. Power is Chairman of the Department of Petroleum Engineering, The University of Texas, Austin.

*For a study of U. S. petroleum engineering education, see "So you Want to Be a Petroleum Engineer?" by Harry H. Power, *The Petroleum Engineer*, January, 1958, Page E-3.

members of the University, of industry, and of the engineering staff of the Petroleum Institute. Options are offered in prospecting and in drilling and production.

Activities of the research departments of the Institute are designed to develop scientific knowledge and techniques in the petroleum industry. In addition, research is conducted in the school for its own ends and to incite the participation of other French research organizations. Engineers may carry out special research programs during the course of their careers. Four research departments of particular interest are: (1) Sedimentary geology, (2) geochemistry, (3) drilling and well completion, and (4) production and study of oil fields.

Engineering at Lima

One institute of higher learning in Peru graduates engineers specializing in petroleum. This is the National University of Engineering at Lima. The school has a 5-year course.

National University of Zulia

School of Petroleum Engineering at the National University of Zulia, Maracaibo, Venezuela, was established September 4, 1952, to satisfy the needs in training petroleum engineers in one of the world's largest oil producing countries — Venezuela.

The program of study compares favorably with similar curricula offered by schools in the United States. By special donations of the Venezuelan Government and contributions from the oil and service companies, the school has modern buildings and equipment.

The five-year course, on a unit basis, is distributed by subjects, as follows: Mathematics 20, chemistry 9, physics 9, geology 12, mechanics 10, language and humanities 14, mechanical engineering 11, civil engineering 12, electrical engineering 6, chemical engineering 10, administration 5, and petroleum engineering 34. Total: 152.

Other Curricula Abroad

Other curricula and options in petroleum engineering have been established at the University of Cairo (Egypt), at several technical institutions in West Germany and elsewhere in Europe.

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★ ★ ★

Wanted:

RETIRED EXECUTIVE SPECIALISTS

If you are retired, here's a job opportunity . . .
If you need expert help, here's a place to find it

WALTER D. FULLER, long-time president and board chairman of famed Curtis Publishing Company and now in retirement, has set up an organization which bids fair to solve many a knotty problem of management, bring constructive business activity to many an executive retiree.

"Every business has problems," says Fuller. "Losses to American business through unnecessary wastes of time and material, poor method, ineffective selling, complacent management, run into millions of dollars every day. Many executives are so busy and so close to their day by day operations that problems which are not pressing are put aside — usually at considerable expense."

Fuller points out that the purpose of his organization is to locate in nearly every segment of business or the professions the experienced management specialists now retired or on pension, who out of many years of background are most competent to solve business problems. The organization finds such people, appraises their ability, energy, "will to do," health and other assets, and makes the best of them available for part-time assignments.

Among such specialists are experts in solving problems in sales, in advertising, in product management, in taxes, in insurance, in restrictive and handicapping legislation (national, state, and local), in opportunity exploration, in business law, in plant location (domestic and foreign), in public relations, in office organization, in mechanization, in engineering, in transportation, in building management, in financial management, in banking and trust activities, in editorial, writing or art, in employment and employee relations, in research, in accounting.

These people are intentionally sought among the retired and the pensioned for they must have had long experience and specialization and should have no other compelling business ties.

All of these specialists are paid by the job on a fee basis — not on payroll. Hence there are no headaches of continuing employment, Social Security, pensions or organization irritation. Fuller asks no payment from specialists for registration, no charge is made when they are assigned to a job, nor does he collect any part of the fee they receive. His charges are paid entirely by those who ask him to recommend specialists to them.

Upon request, Fuller provides an outline of the experience and capacity of several specialists who have been found through investigation to be competent in the field desired. The client then makes his selection and pays a fee. Fuller's organization proceeds to analyze the situation and complete the arrangements with the specialist or it introduces the specialist to the client and the two come to an agreement on amount of fee, time required, expense accounts, and other details.

Fuller says that persons on its specialist list during their active employment before retirement were too busy and too closely tied to regular jobs for them to take on outside work, but with the present-day expansion of compulsory retirement at 65 and with Social Security and other considerations, such persons are now becoming available for assignment.

The company sifts out the most able for analysis and action in each line of business and makes them available. These people neither wish nor expect permanent jobs but the best, most active, and most ingenious of them like temporary assignments and they can prove very valuable to those who use their services, according to Fuller.

Fuller believes his company provides the necessary link between the business with a problem and the individual who can solve it. Its people are independent contractors; the Fuller company acts as their agent.

The Fuller Company seeks to expand its list of retired and pensioned specialists and in this connection invites correspondence with organizations which recently retired executives.

Address is Walter D. Fuller Company, Public Ledger Building, Philadelphia 6.

(Reprinted from *Stet*, published by Champion Paper & Fibre Company, Hamilton, Ohio.)

PERU'S PETROLEUM LAWS INVITE PRIVATE CAPITAL

Terms favor operations in Eastern Zone where concessions are granted for longer periods and cost less . . .

ALL HYDROCARBON DEPOSITS in Peru are property of the nation. Exploration and exploitation of these deposits and manufacture, refining, transportation, and storage of petroleum and products are public utilities, handled by national or foreign persons or private companies under concessions granted by the National Government. The term hydrocarbons includes asphalt, natural gas, and all other products that are found associated with petroleum deposits.

Peru's Petroleum Law provides for division of the national territory into four zones: Coastal Zone, from the Ecuadoran to the Chilean boundaries and from the Pacific Coast to a contour line of 2000-meter elevation on the western slope of the Andes; Sierra Zone, a strip between the 2000-meter contours of the western and eastern slopes of the Andes and from the northern to the southern frontiers of the country; Eastern Zone, all territory east of the 2000-meter elevation contour of the eastern slope of the Andes, and Continental Shelf Zone, extending 200 miles west from the coastline.

Originally set aside as a government reserve, the Continental Shelf Zone was opened to exploration and exploitation in 1953. In general, the same rights apply as in the Coastal Zone.

Concessions may be granted for exploration; for exploitation; and for manufacturing, refining, transportation, and storage.

Exploration concessions confer right to explore determined areas for a period of 3 years in the Coastal Zone, 5 years in the Sierra, and 6 years in the Eastern Zone. Periods may be extended upon application. Maximum area for each concession is 20,000 hectares (49,420 acres) in the Coast and Sierra Zones and 50,000 hectares (123,355 acres) in the Eastern Zone. One concessionaire may hold up to 20 concessions in each zone. A larger area in Peru is under oil concessions than in any other Latin American country, including Venezuela.

Any firm or person that wishes to engage in exploitation, processing, transport, or storage of petroleum and petroleum products must apply to the Ministry of Development and Public Works, submitting plans of the proposed installation. Manufacturing, refining, transportation, and storage concessions have a duration of 40 years and are extendable for an additional 40 years.

The Petroleum Law allows a 50-percent reduction in import duties and other import taxes on machinery, derricks, drilling equipment, piping, tanks, tools, and other material destined for exploration or exploitation concessions in the Eastern and Sierra Zones for a period of 30 years following the date the concession is granted. Refining, transportation, and storage concessionaires in any zone may be granted, upon application, exemption from the payment of import duties and the import taxes on equipment, materials, machinery, and other necessary items for the installation and operation of their facilities.

All concessionaires may be granted exemption from payment of all import duties on special necessary equipment for a period of 2 years. Exemption can be extended an additional 2 years. Upon expiration of the original term or its extension, the equipment must be re-exported or the duties paid.

A Supreme decree of October 16, 1953, extends similar temporary free-entry privileges to firms under contract to do geophysical, exploration, or drilling work. Application must be made to the Bureau of Petroleum, Ministry of Development and Public Works, for any import duty exemption that may be allowed.

Taxes on petroleum exploration and production were changed in 1950 when the law regulating petroleum concessions and reserves was revised. On the whole, taxes are applied equally to foreign and domestic companies except that domestic companies receive better treatment in depletion allowances.

Business profits from refining, manufacturing, transporting, or storing petroleum products are taxed at the ordinary rates (maximum of 40 percent) applicable to business. Crude oil production activities, in addition to paying an income tax at the rate of approximately 50 percent, also pay surface exploitation (production) taxes.

One tax advantage in the Petroleum Law is that companies granted petroleum exploitation concessions, which can run as long as 40, 45, or 50 years, depending on location of the concession, are guaranteed that no other taxes or increases in taxes will be imposed on them for production for the duration of the concession.

Tax rates on exploration and exploitation activities vary by petroleum zones. In general, taxes are highest for the more accessible Coastal Zone, lower in the intermediate Sierra Zone, and lowest in the far removed Eastern Zone.

The concessionaire first pays a deposit per hectare which will be forfeited if he does not comply with regulations. Then he pays a surface tax annually. When an exploration concession is granted an initial tax is collected; also a lease rental tax which can be lowered by production volume.

In the Coastal Zone, the surface tax per hectare per year is 2 soles* during the original period of the concession (3 years), 4 soles during the first extension period (1 year), and 6 soles during the second extension period (1 year).

In the Sierra Zone, the rate per hectare per year is 1 sol during the original period of the concession (5 years), 2 soles during the first extension period (2 years), and 3 soles during the second extension period (2 years).

In the Eastern Zone, the rate per hectare per year is 0.50 sol during the original period of the concession (6 years), 1 sol during the first extension (2 years), and 1.50 soles during the second extension period (2 years).

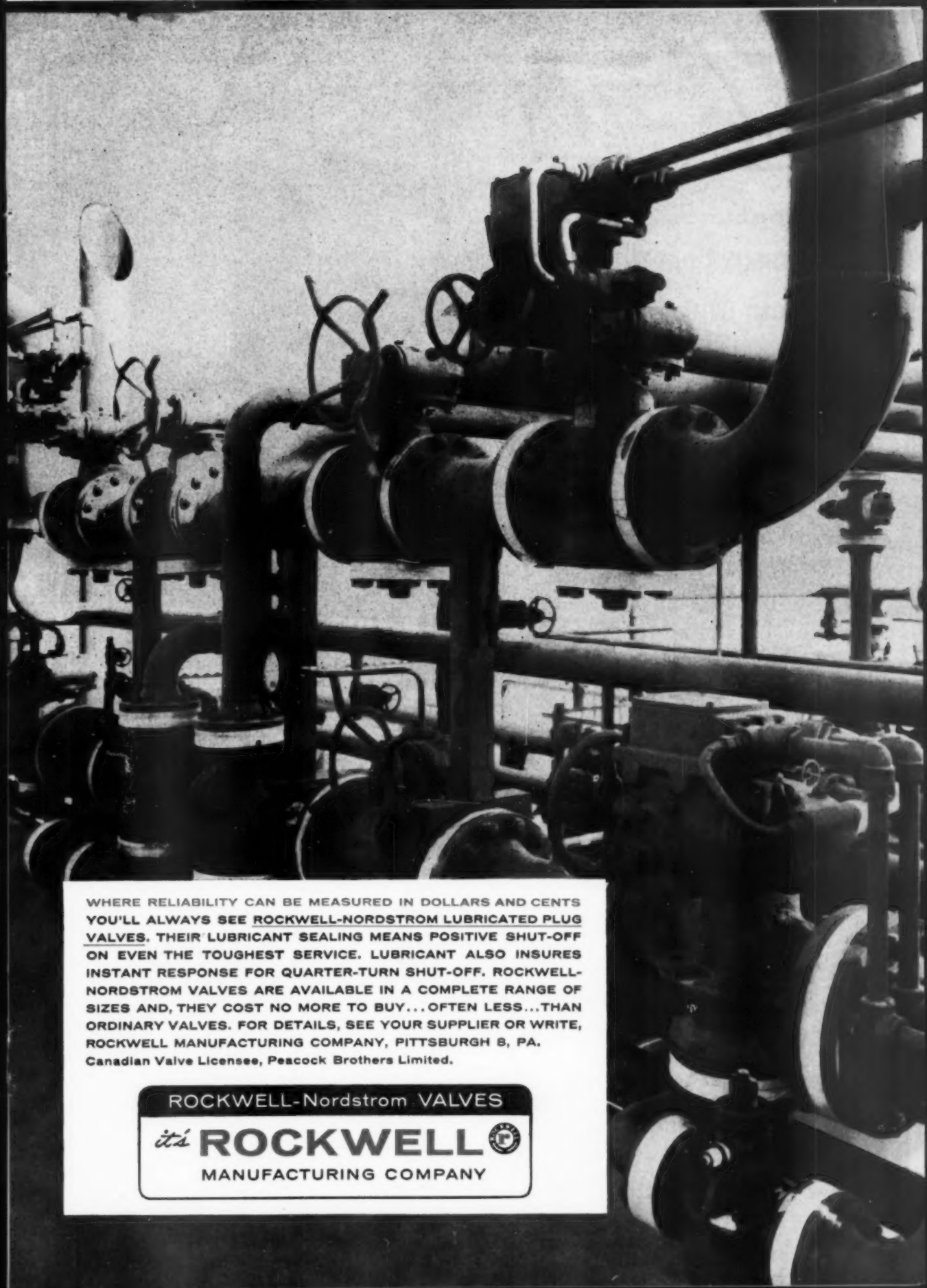
There is a 15 percent depletion allowance for the Coastal Zone (25 percent for domestic firms) and 27.5 percent for the Sierra and Eastern Zones. The allowance cannot exceed 50 percent.

Income tax is 50 percent of net income although this begins for concessions in the east part at 10 percent during first 10 years and rises to 50 percent after 30 years.

Petroleum operations are also subject to Unemployment Fund Tax and to Mining Bank Fund Tax. Each is assessed on exports. ★ ★ ★

From "Investment in Peru," U.S. Department of Commerce, May 1957.

*1 Sol = 4.6 cents; 1 hectare = 2.4711 acres.



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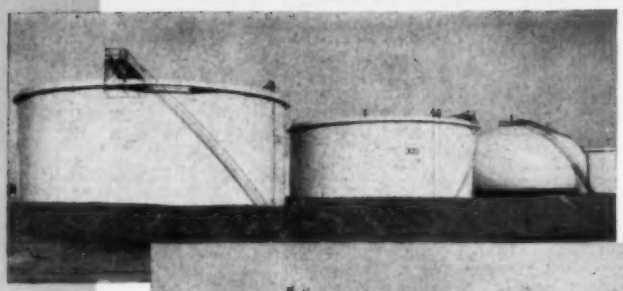
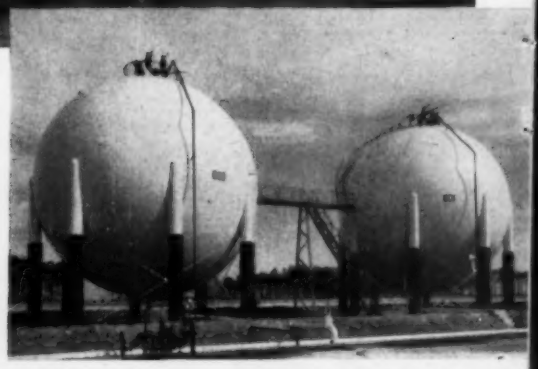
77

CB&I Structures serve as WORKING PARTNERS for American Oil Company Refinery





Where there are refining operations there are sure to be welded steel storage and processing structures built by CB&I... *Working Partners* built to exacting specifications because they are backed by the expert and *coordinated* design, engineering, fabrication and erection services that are available from CB&I.

At American Oil Company's 35,000,000-bbl. per day Yorktown, Virginia, refinery 77 CB&I-fabricated structures play an important role. Reactor, regenerator, crude, vacuum and absorber towers and catalyst hoppers are teamed with 62 Horton storage tanks, Hortonspheres® and Hortonspheroids® to serve many phases of this modern, efficient refinery operation.

Yes, where there's refining—you'll find the experienced *craftsmanship in steel* that is CB&I. A new booklet describes CB&I FIELD SERVICES. Write our nearest office for a copy.

Top: Horton Pontoon Floating-Roof tanks, Hortonspheroids and Hortonspheres at Yorktown refinery.

Left: American Oil Company's modern orthoflow converter makes extensive use of CB&I-fabricated components. Equipment was furnished through M. W. Kellogg Company.

P60CB(R)

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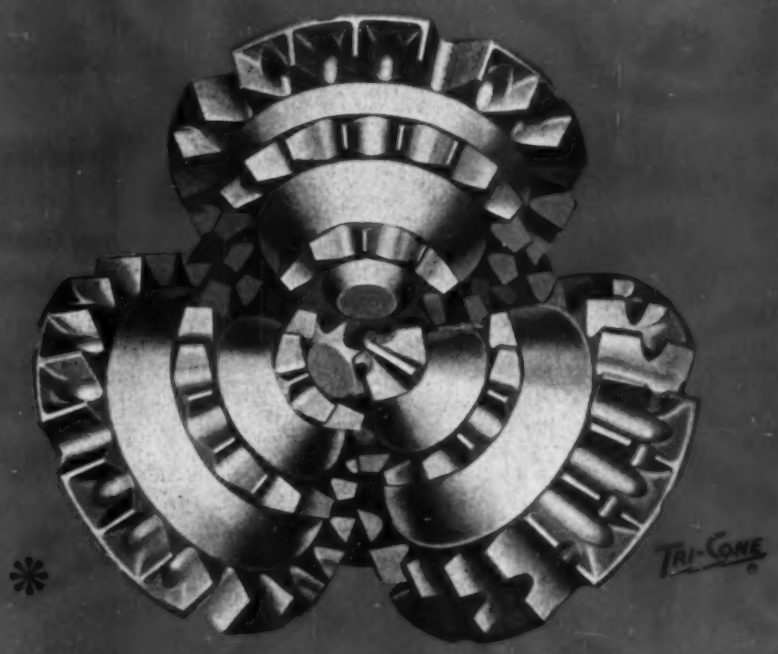

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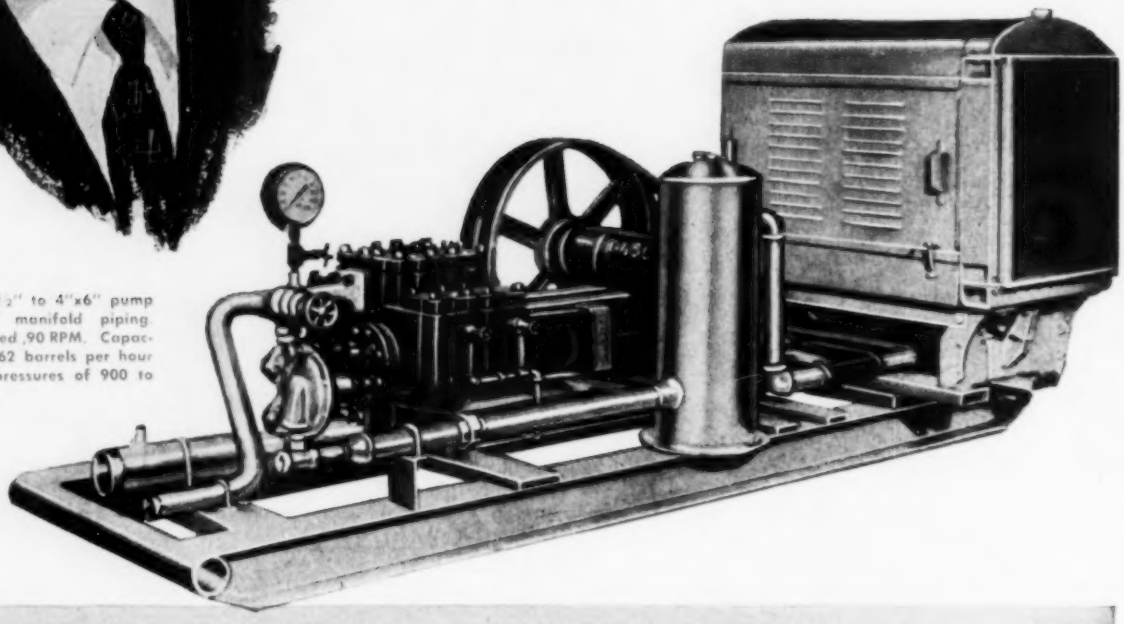

Fig. 1849—2½" to 4"x6" pump with special manifold piping. Maximum speed 90 RPM. Capacities, 59 to 162 barrels per hour at working pressures of 900 to 350 PSI.

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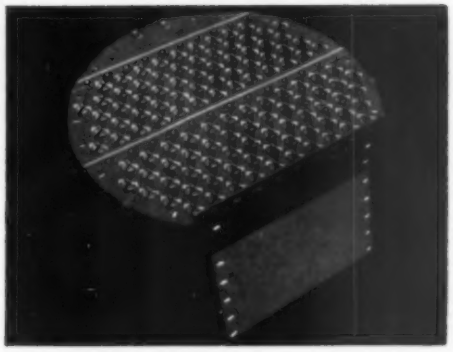

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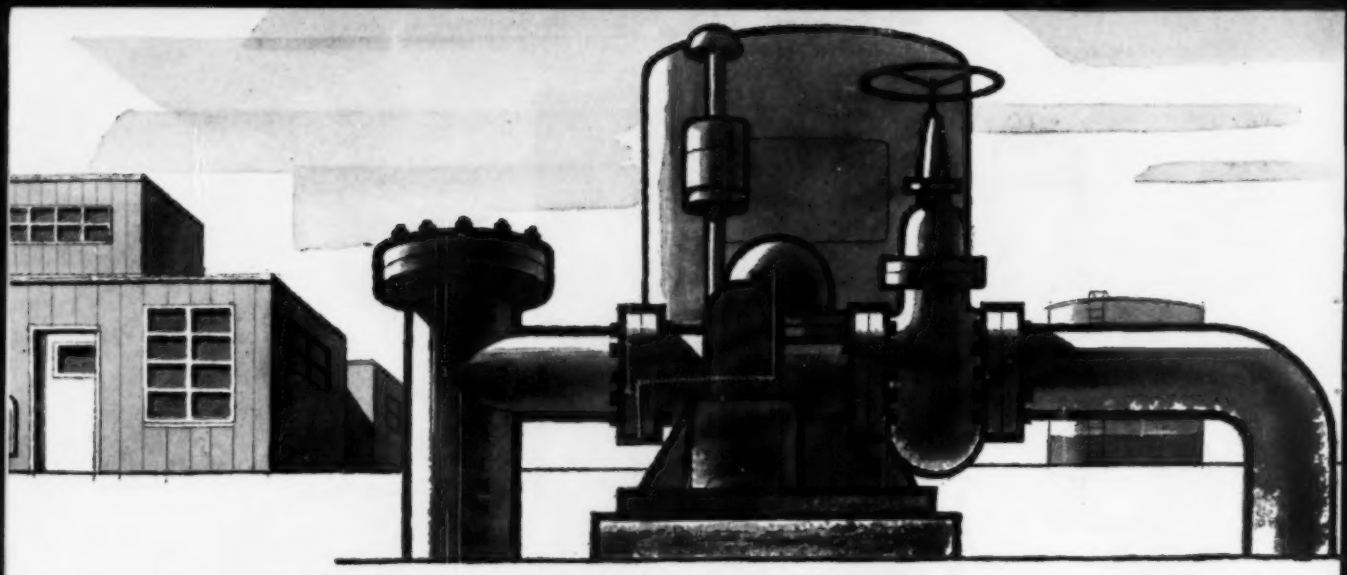

New PACKAGED Pipeline Control System cannot tell a lie!

SEE IT AT
BOOTH 75, 76, 77
PIEA
CONFERENCE
Dallas, Texas
April 29, 30,
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Designed by the pipeline industry for the pipeline industry

For years, now, Union Switch & Signal has been designing custom control systems to solve individual problems for pipeline companies. Out of this experience has come a realization of your requirements and the need for a simple *standardized* system capable of easy expansion . . . with the lower cost advantages of package design being passed on to you. That system is now available.

This new modular C.T.C. System concentrates all apparatus for the supervisory control of a station on two 19″-wide racks. One rack goes in the controlling office, the other goes at the field location being controlled. It provides display of indications and alarms and can easily be adapted to handle telemetering and other data. Future additions or changes to the system can be made without changing the basic circuits.

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Rugged, industrial-type control components—designed and built by Union Switch & Signal itself—give this system the reliability you need in pipeline operation. But it goes further than mere reliability. Like other UNION C.T.C. Systems, this new system *checks itself* for error before implementing a control.

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This is the system you need to insure fail-safe operation. It is the system you need to trim the cost of single station controls. See it demonstrated at the PIEA Conference in Dallas. And watch for future standardized systems now being developed by Union Switch & Signal.

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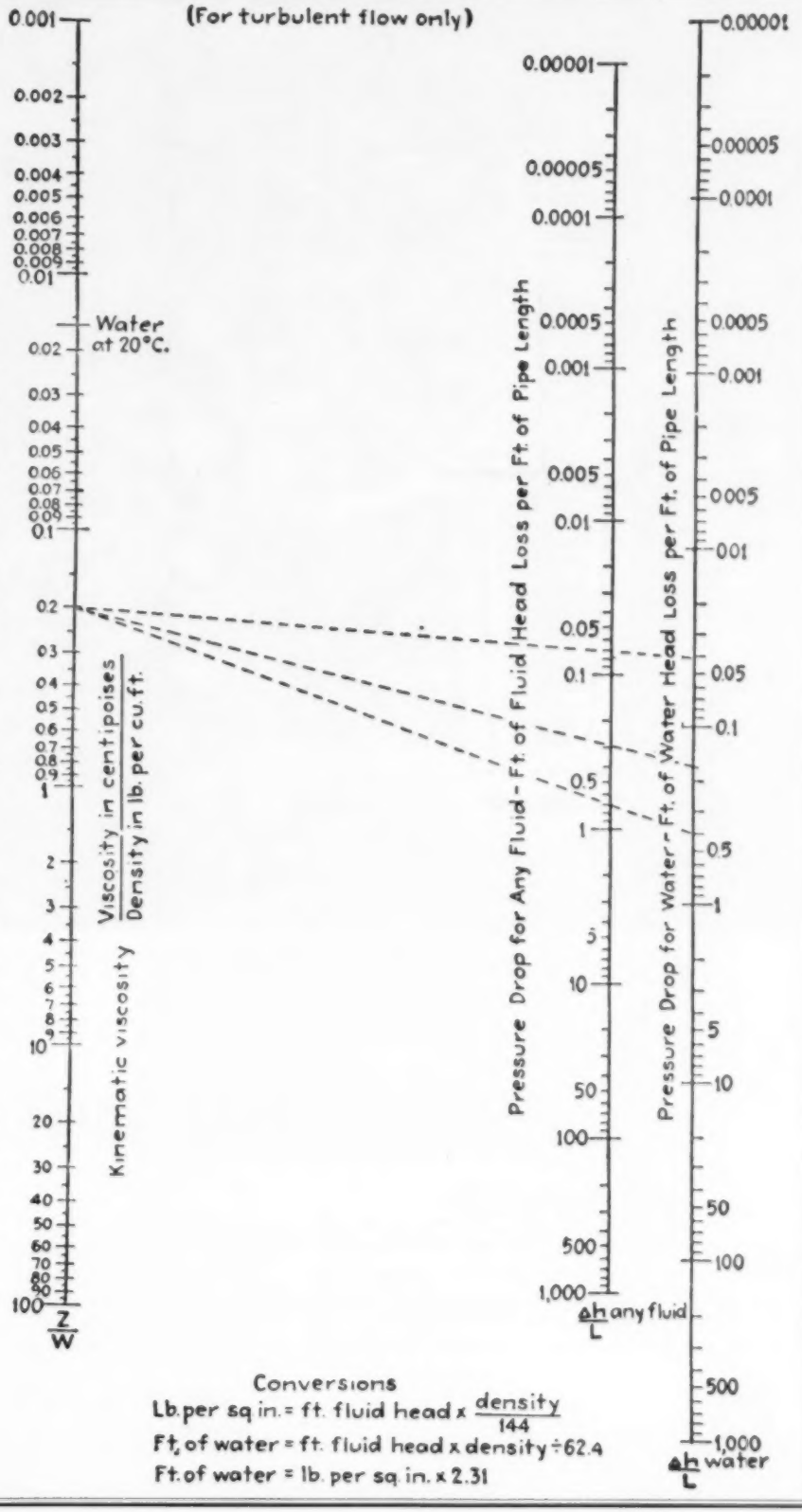
PRESSURE-LOSS CONVERSION CHART FOR PUMPING FLUIDS

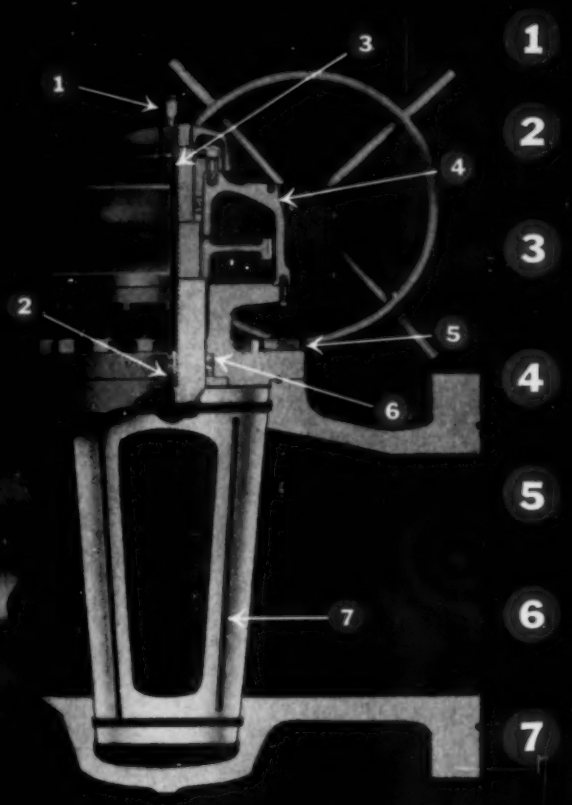

(For turbulent flow only)
Water at 20°C.
Kinematic viscosity
Viscosity in centipoises / Density in lb. per cu. ft.
Z/W
Pressure Drop for Any Fluid - Ft. of Fluid
Head Loss per Ft. of Pipe Length
Δh any fluid / L
Pressure Drop for Water - Ft. of Water
Head Loss per Ft. of Pipe Length
Δh water / L
Conversions
Lb. per sq. in. = ft. fluid head x density / 144
Ft. of water = ft. fluid head x density ÷ 62.4
Ft. of water = lb. per sq. in. x 2.31

Among the most convenient ways of calculating the friction loss in a pipe for a liquid other than water is to determine the friction loss with water and then convert to the loss with the liquid actually flowing in the pipe. Numerous handbooks and tables give the friction loss for water in various types and sizes of pipe and various rates of flow.

In converting friction loss with water to the friction loss of the liquid being piped, the absolute viscosity of the liquid at the average flowing temperature must be known and its specific weight. The kinematic viscosity may then be found and the friction loss converted from that of water under the same conditions.

Reproduced by permission of *Chemical and Metallurgical Engineering*, January, 1943, from article by W. E. Pratt, Worthington Pump and Machinery Corporation.

7 characteristics that make WALWORTH a better Lubricated Plug Valve



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2. Double ball check valve prevents line pressure from getting into lubricant system.
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4. For buried pipelines—gear housing design permits simple attachment of lubrication and handwheel extensions without modifying the gearcase.
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*Du Pont registered trade-mark

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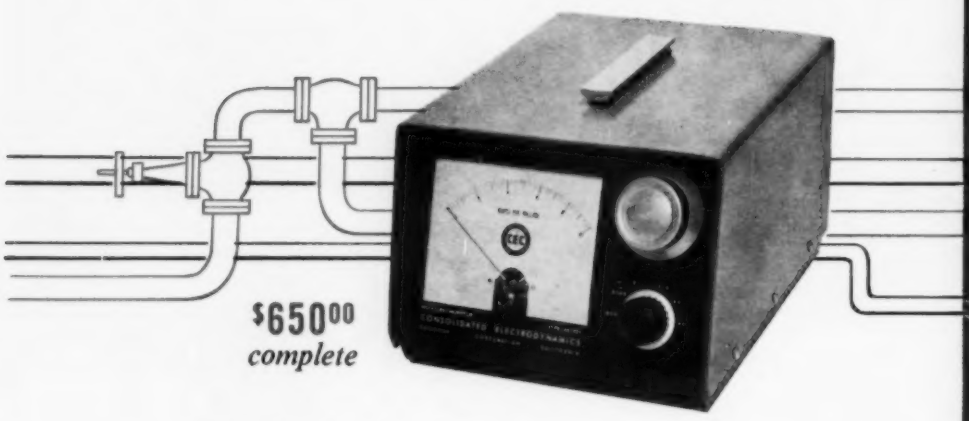

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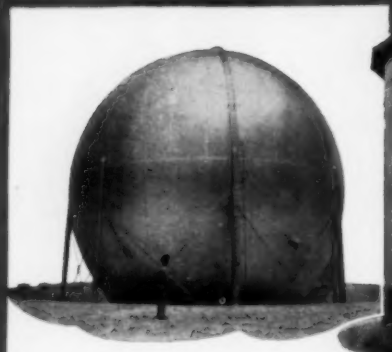
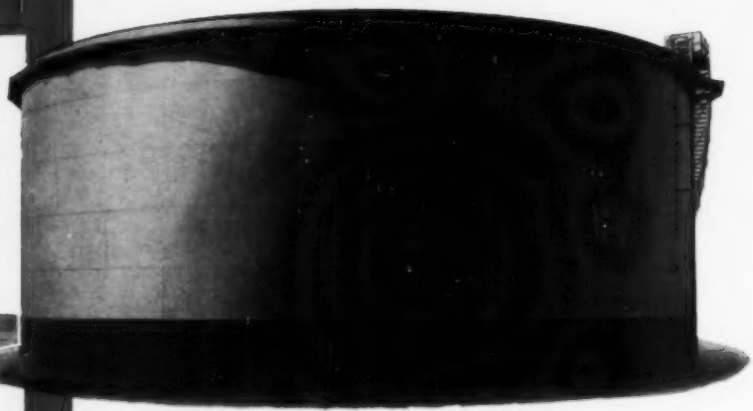
BIALIFT* tank with vapor-saver diaphragm



Hammond Sphere



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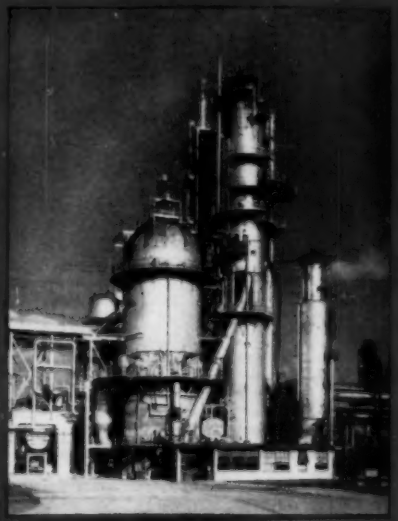

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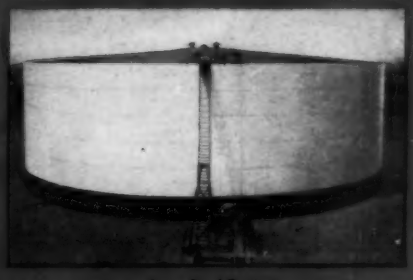

Cone Roof Tanks

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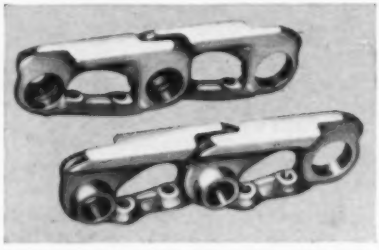
Careful selection of material gives greater strength to new D8 strutless track links

Quality doesn't just happen. The world-famous quality that is the hallmark of Caterpillar earthmoving equipment is a direct result of never-ending research, the finest possible materials, and persistent attention to every manufacturing detail. This is true of Caterpillar machines. And it is true of Caterpillar parts.

The new, strutless link for Cat D8 Diesel Tractors is an example of this emphasis on quality. Each link is able to bear the entire weight of the tractor, over and over again, in the roughest of terrains and climates. This is how Caterpillar makes sure these links meet this challenge:

All steel used for links is given an extensive series of tests *before* manufacture. In the Caterpillar Metallurgical Laboratory it is first analyzed for chemical composition by a spectrograph—slight variances in chemical make-up can result in big differences in the finished product. Then the steel is tested for hardenability; in other words, the degree to which it will respond to heat treating. Resistance to impact loads is measured to insure the track link will give maximum performance under all conditions. Steel that cannot be made into Caterpillar quality links is rejected.



New, strutless link for Caterpillar D8 Diesel Tractors.

The new D8 link is forged—the best way to make a link. Forgings are more dense. They have "inner flow lines"—the equivalent of grain in wood—following the contour of the part, providing greater strength at critical locations as well as resistance to breakage.

"Dubbed-off" link ends eliminate damage to rollers and mating links. Strategic designing of steel into the bushing boss and arch improves fatigue strength. Links are *double* heat treated, furnace heated for a tough core, and "Hi-Electro" hardened for a deep, superhard rail surface.

Features like these mean one thing. A Caterpillar part is your best buy. Your Caterpillar Dealer has full information on the new D8 strutless links and the other quality Cat parts. See him today.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

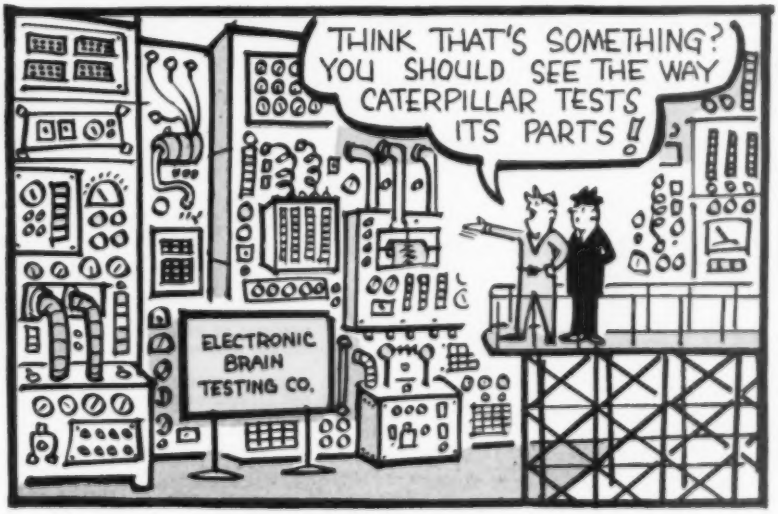
SERVICE TIP

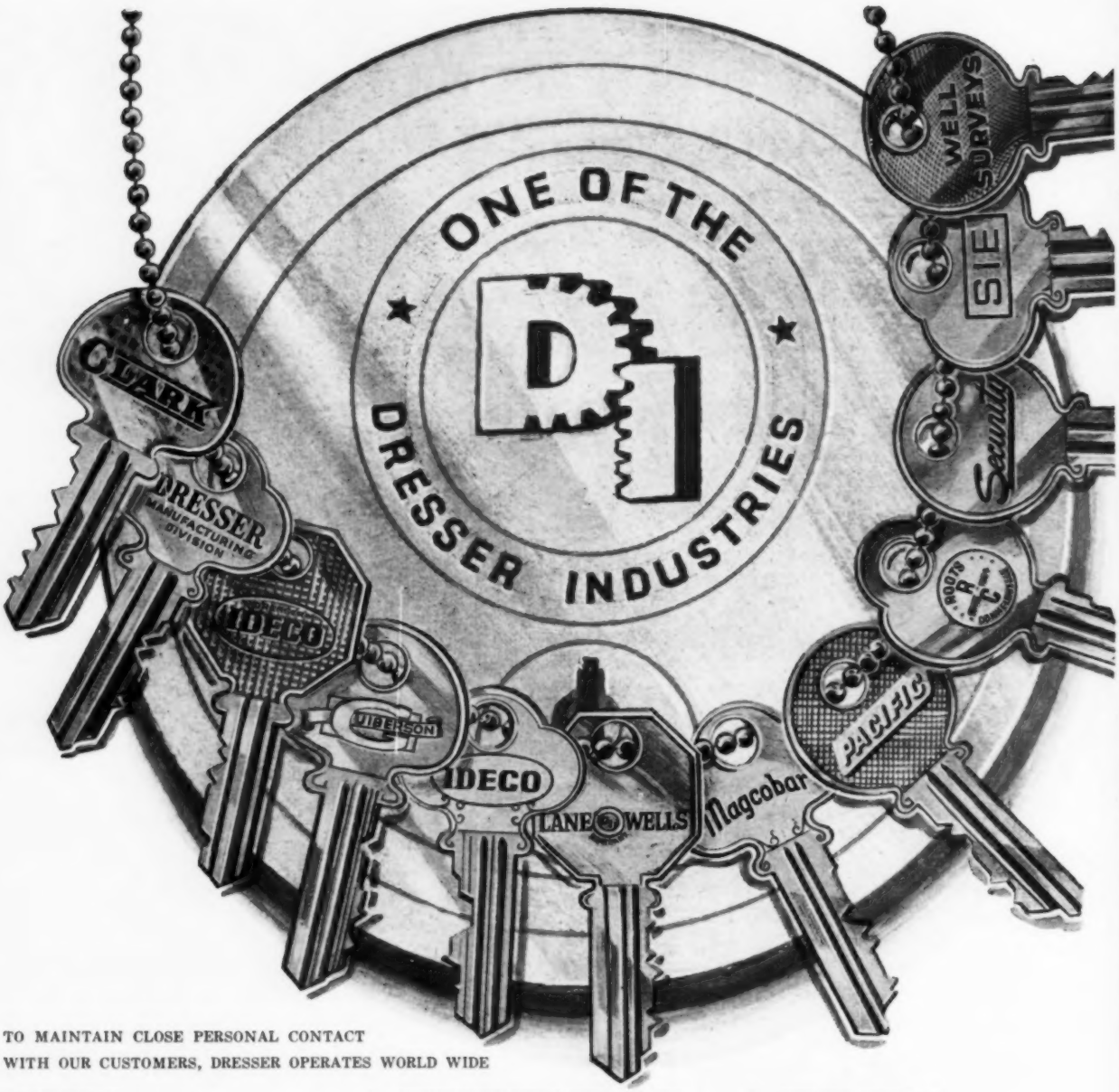
For maximum life, tracks should have 1½" to 2" of slack. Your Operation and Maintenance Instructions have complete adjustment details.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

LINK STRENGTH is measured on this hydraulic press. The design of Caterpillar track parts is under constant examination by the most extensive research facilities in the industry.





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WITH OUR CUSTOMERS, DRESSER OPERATES WORLD WIDE

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Keyed to your needs and linked to give DRESSER Plus + service

"One of the Dresser Industries" is a well known phrase identifying the family relationship of 12 great Dresser companies which supply equipment and technical services to the oil, gas, chemical, electronic and other industries.

Each Dresser company is independently managed for maximum efficiency. Each possesses global experience, engineering talent and modern manufacturing facilities keyed to the highly technical needs of the industries it serves. Linked by common ownership, Dresser companies can be quickly mobilized to meet special conditions calling for specialized research, engineering or production facilities. This coordinated teamwork is known as Dresser *plus* + service. It's an *extra* value provided promptly by men with imagination. The Dresser *plus* + is your positive assurance of superior equipment and technical services — the standard of comparison the world over.

Tomorrow's progress planned today

DRESSER INDUSTRIES, INC.

EQUIPMENT AND TECHNICAL SERVICES

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ELECTRONIC
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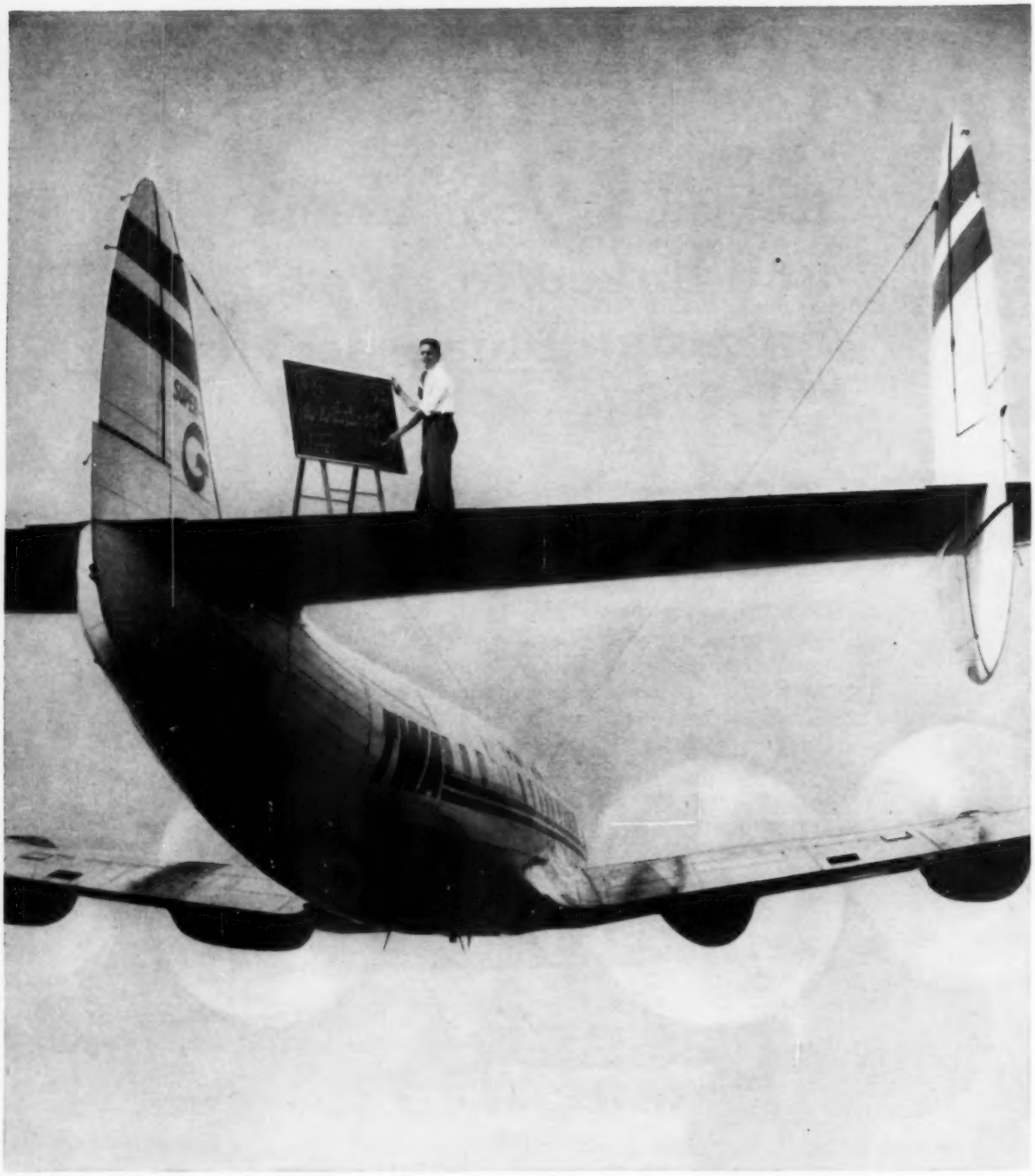
These are the Dresser Industries:

CLARK BROS. CO.—*compressors* • **DRESSER-IDECO COMPANY**—*steel structures* • **DRESSER MANUFACTURING DIVISION**—*couplings* • **THE GUIBERSON CORPORATION**—*oil tools* • **IDECO, INC.**—*drilling rigs* • **LANE-WELLS COMPANY**—*technical oilfield services* • **MAGNET COVE BARIUM CORPORATION**—*drilling mud* • **PACIFIC PUMPS, INC.**—*pumps* • **ROOTS-CONNERSVILLE BLOWER DIVISION**—*blowers* • **SECURITY ENGINEERING DIVISION**—*drilling bits* • **SOUTHWESTERN INDUSTRIAL ELECTRONICS**—*electronic instrumentation* • **WELL SURVEYS, INC.**—*nuclear and electronic research and development.*



Oilmen <u>should</u> be up in the air. An oil company physicist and his slate of equations may seem out of place in the sky. But airmen couldn't get off the ground without oilmen. Oil helped fly more than 50 million passengers on U. S. air lines last year. Oil research helps new jet passenger planes span the country in less than four hours. Remember these things when you hear misinformed people talk against your industry. Speak up then and there—tell how you help give America wings! **SHELL OIL COMPANY**

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

HOW TO BE A HERO AT INCOME TAX TIME

(And save yourself a few dollars, too!)

FIND YOUR STATE TAX HERE!

Based on tax rates as of October 1, 1957 (in cents per gallon).

	State	Federal	Total
Alabama	7	3	10
Arizona	5	3	8
Arkansas	6.5	3	9.5
California	6	3	9
Colorado	6	3	9
Connecticut	6	3	9
Delaware	5	3	8
Dist. of Col.	6	3	9
Florida	7	3	10
Georgia	6.5	3	9.5
Idaho	6	3	9
Illinois	5	3	8
Indiana*	6*	3	9
Iowa	6	3	9
Kansas	5	3	8
Kentucky	7	3	10
Louisiana	7	3	10
Maine	7	3	10
Maryland	6	3	9
Massachusetts*	5.5*	3	8.5
Michigan	6	3	9
Minnesota	5	3	8
Mississippi	7	3	10
Missouri	3	3	6
Montana*	7*	3	10
Nebraska*	7*	3	10
Nevada	6	3	9
New Hampshire*	6*	3	9
New Jersey	4	3	7
New Mexico	6	3	9
New York (State)	4	3	7
N. Carolina	7	3	10
N. Dakota	6	3	9
Ohio	5	3	8
Oklahoma*	7.5*	3	10.5
Oregon	6	3	9
Pennsylvania*	5*	3	8
Rhode Island	4	3	7
S. Carolina	7	3	10
S. Dakota*	6*	3	9
Tennessee	7	3	10
Texas	5	3	8
Utah*	6*	3	9
Vermont*	6.5*	3	9.5
Virginia	6	3	9
Washington	6.5	3	9.5
W. Virginia	6	3	9
Wisconsin	6	3	9
Wyoming	5	3	8
U. S. Average	5.8	3	8.8

*Changes during year: Ind.—tax was 4¢ before 3/15/57; Mass.—tax was 5¢ before 6/1/57; Mont.—rate will be 6¢ effective 1/16/58; Neb.—rate was 6¢ before 9/20/57; N. H.—tax was 5¢ before 9/1/57; Okla.—rate which was increased on 6/1/57 dropped back to 6.5¢ by 12/31/57; Penn.—tax was 6¢ before 6/1/57; S. D.—tax was 5¢ before 7/1/57; Utah, tax was 5¢ before 5/14/57; Vt.—tax was 5.5¢ before 7/15/57.

STEP #1 **Just tell your friends** that their state gasoline taxes can be deducted on their Federal Income Tax. (Other taxes, such as state and local sales taxes, may also be deducted but under a different formula.)

STEP #2 **It's so easy.** You'll find your state gasoline tax on the tax list on this page. Multiply that by the number of gallons purchased in 1957.

STEP #3 **Here's an example:** Friend "A" drove 10,000 miles last year and got 14 miles per gallon. That's 700 gallons of gasoline. Say your state tax rate is 6¢ a gallon. 700 times 6¢ is $42. So friend "A" gets a $42 deduction on his Federal Income Tax. You're a hero! And you've made a friend for your industry!

You can make even more friends for your industry when you tell people that they drive a bargain with today's gasoline. The price of gasoline itself has gone up only 17% in the last decade while taxes have gone sky high. For every dollar they spend on fuel itself, they spend an additional 40¢ in federal and state taxes. Mail the coupon below for more information about today's gasoline.

American Petroleum Institute, Dept. G
50 W. 50th Street, New York 20, N. Y.

I would like to obtain more information about today's gasoline quality, prices and taxes. Please send me your FREE booklets.

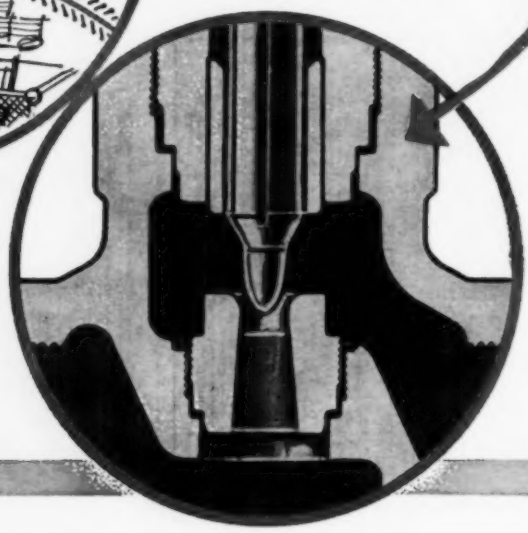
NAME _____

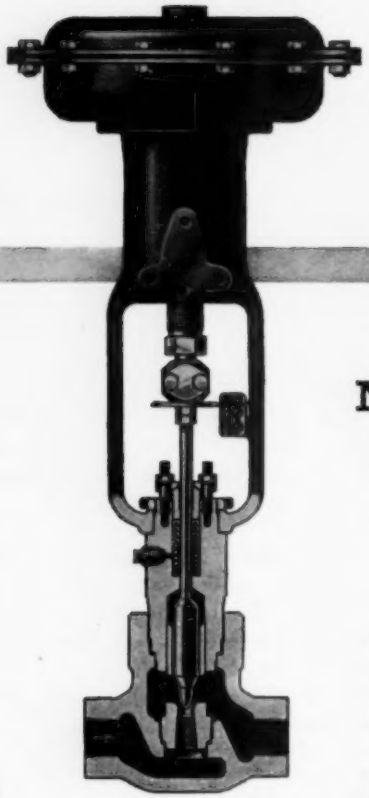
ADDRESS _____

CITY _____ ZONE _____ STATE _____

But...

No extra charge for this seat





NOW YOU GET STELLITE FACED SEATS ON ALL "D" BODIES

Now, for the first time, Fisher places Stellite on the facing of the seat ring and inner valve in high pressure "D" Bodies at no extra cost. This extra measure of protection resists erosion due to sand, foreign matter or high pressure—greatly increases life of regulator under adverse service conditions.

Available for working pressures up to 6000 pounds in sizes ½" through 2". 1" and 2" sizes, however, can be supplied when required for pressures up to 10,000 pounds. Also available in angle bodies (Type 667-DA) in sizes of 1" through 2" with working pressures up to 6000 pounds.

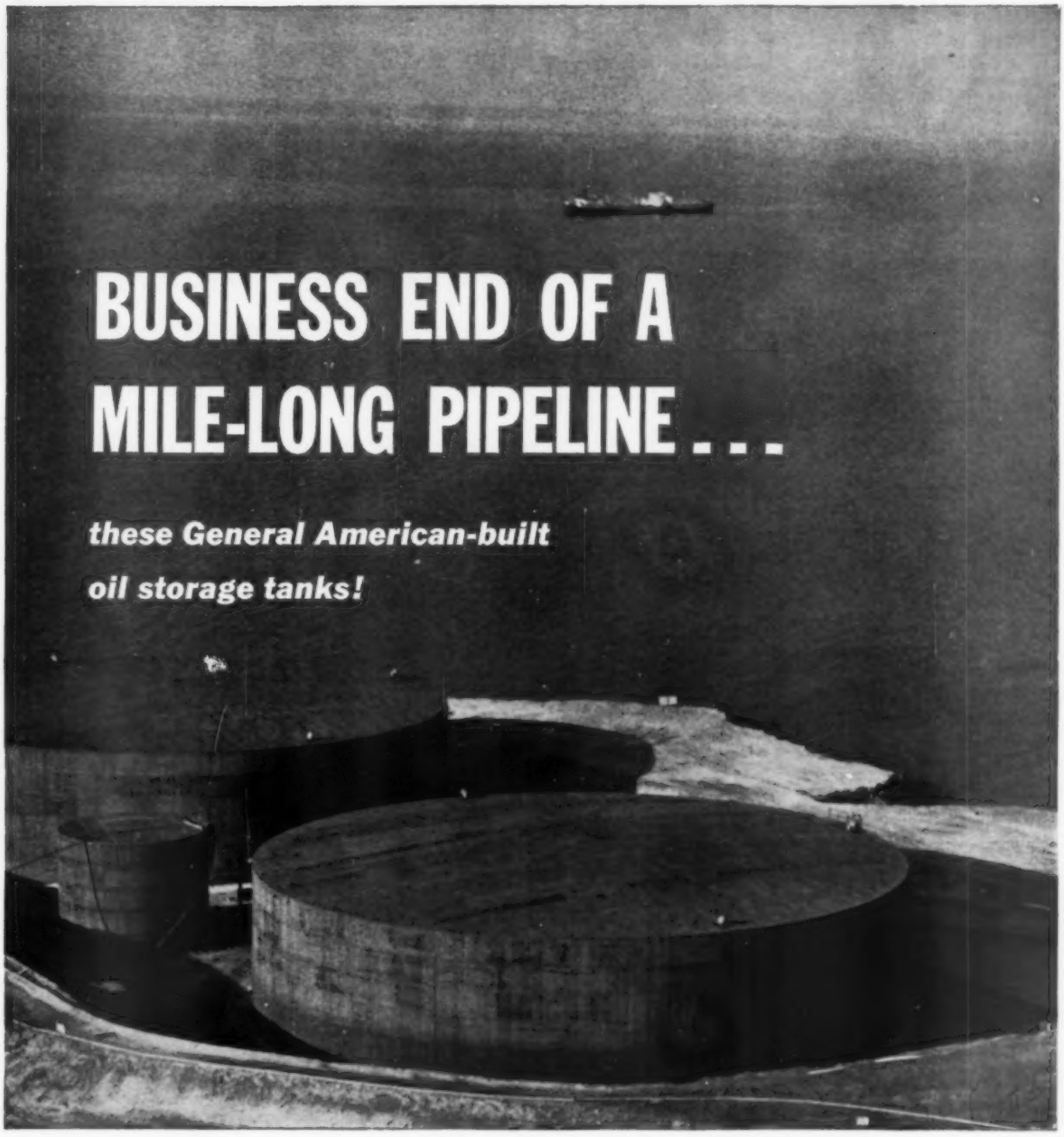
IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

FISHER® Controls

SINCE 1880



Moored more than a mile offshore in 70 feet of water, even the world's largest tankers (or any tanker presently contemplated) can deliver cargoes direct to these twin 268,000-barrel storage tanks . . . eliminate double handling and costly barging charges.

Each 200 feet in diameter, 48 feet in height, the tanks were custom-engineered, erected on the site by General American's Plate and Welding Division for Northville Dock's new Long Island Terminal. New York State's largest tanks . . . they provide storage for 22,500,000 gallons of oil.

If you need expanded storage right now, or as insurance against future demands, look into the facilities offered by General American. Whatever your storage problem—liquid or gaseous—you'll find . . . *it pays to plan with General American.*

PLATE & WELDING DIVISION
GENERAL AMERICAN

PLATE AND WELDING DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street
Chicago 90, Illinois

THREE New International V-8's

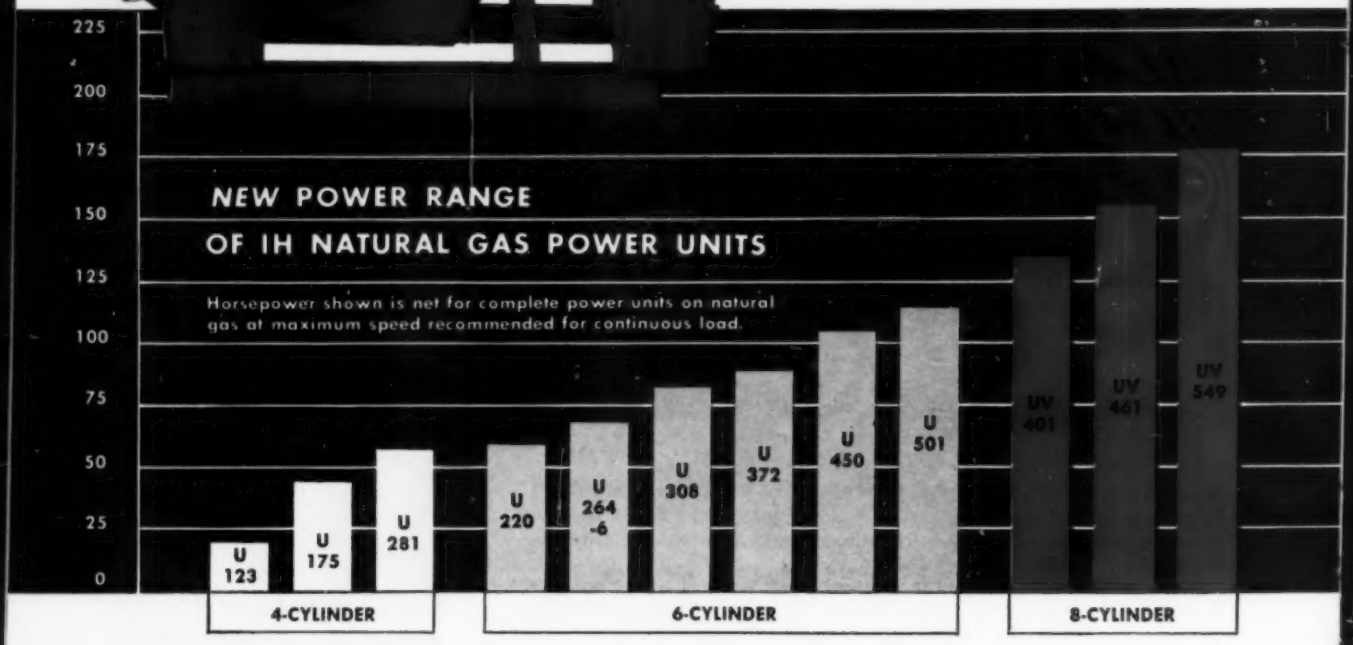
Now you have an even wider selection of economical International valve-in-head gas power for your oil field needs – three new power-packed, compact V-8's – the UV-549, UV-461, and the UV-401.

NEW V-8 UV-549 POWER UNIT. 178 net hp @ 2,600 rpm on natural gas, 200 hp on LPG, and 208 hp on gasoline. Stripped engine develops 257 hp on gasoline at 3,400 rpm.

These new V-8's increase the International carbureted line to 12 models that can be operated on the fuel of your choice—natural gas, LP gas, or gasoline. The bar chart below shows the power range of these 12 units when operating complete with radiator and fan on natural gas. Model numbers indicate piston displacement.

Standout features of the compact new V-8's that help you cut operating costs include: rigid, Y-shaped block; short-stroke, heavy-duty, cam-ground aluminum pistons; big, smooth-running, counterbalanced, tocco-hardened, 5-bearing crankshaft; large-area, long-life, tri-metal, replaceable bearings; combination full-flow, by-pass oil filter for long-life pressure lubrication; full-power, down-draft carburetion; oil cooler; and a 12-volt electrical system.

For the best in dependable power for your pumping, exploratory drilling and servicing rigs, it will pay you to investigate this new International line. You'll get power that outperforms with more in-built values. You'll get power that's backed by fast, efficient parts and service support available to customers throughout the world.



INTERNATIONAL® CONSTRUCTION EQUIPMENT

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Power Units . . . Motor Trucks . . . Farm Tractors and Equipment.

E-12

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Speeds oil field maintenance • construction • material-handling

Consider what the high-speed mobility and *extra capacity* of this Koehring 205 truck crane can mean on your scattered lifting and material handling work around refineries, yards, booster stations, drill sites, etc. It travels anywhere a truck will go — drives 30, 40 miles, or more, in less than an hour's time.

Unrestricted travel

Axle-load distribution of the 205 truck crane conforms with street and highway regulations in most areas, even when carrying 25-foot boom over the steering end. Overall width is 8 feet.

With one of these mobile cranes on hand, you're equipped to lift any load up to 15 tons (based on conservative 85% rating). For high lifts, the pin- or butt-connected crane boom can be extended from 25 to 70 feet. When extra reach is needed, 15 or 30-foot jib can be added to 65-foot boom, for a maximum 95-foot boom-and-jib.

½ to ¾-yard bucket

Heavy lifting capacity and stability of truck mounting increase the 205's work capacity with every attachment. It handles ½ to ¾-yard clamshell bucket on a wide work radius — speeds stockpiling, loading and unloading of coal, chemicals, and other bulk materials.

When there's excavation to be done for new installations, foundation footings, truck-road maintenance, drainage, plant pipeline systems, the Koehring 205 readily converts to dragline, ½-yard shovel or hoe — earns extra savings for you. It's also profitable for "spare-time" rental service to local contractors, cities, and neighboring industries if you like!

Take your choice:

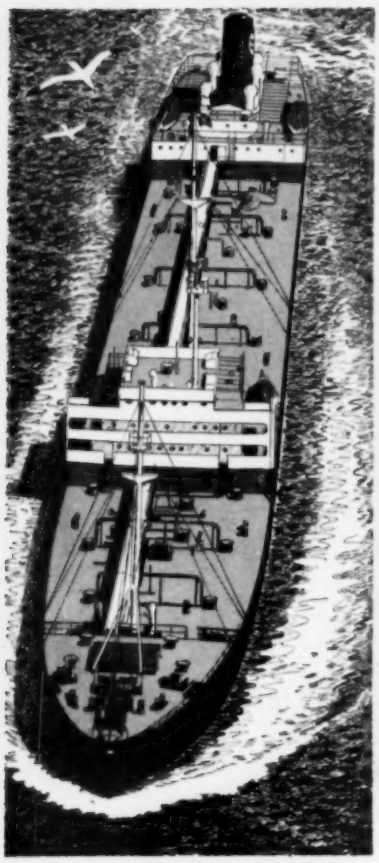
To suit your working conditions, this Koehring 205 is available on a choice of truck, Cruiser®, or crawler mountings. Better see your Koehring distributor about it soon — or write us for more information. Other Koehring sizes up to 95 tons or 3 yards also available.

KOEHRING
DIVISION OF KOEHRING CO.
Milwaukee Wisconsin

K799

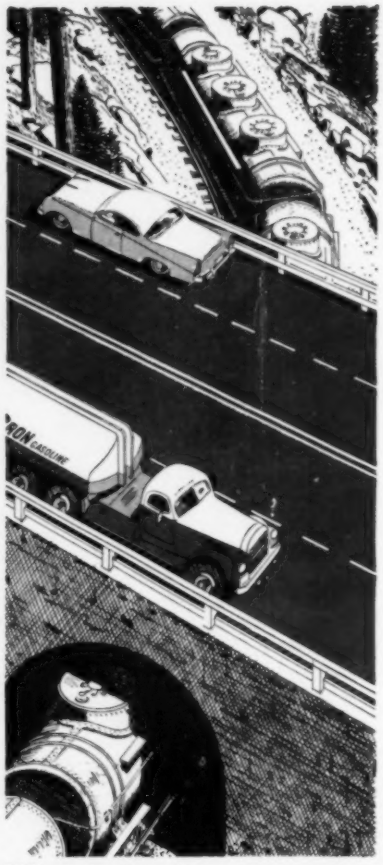
FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

How Standard's busy transportation system helps hold down prices of petroleum products



Twenty-six Standard Tankers—plus others that we charter—sail the seas to keep crude oil moving to refineries and more than a hundred finished products returning to customers. A supertanker can hold enough gasoline to run your car over 10,000 years. On inland waters, tugs, barges and smaller tankers take over the transport job.

Rivers of crude oil and products flow through 3364 miles of pipelines that Standard operates in the Western hemisphere. Also, we pay to send products through other companies' pipelines. They in turn use our lines. Through these "steel arteries," oil is pumped over mountains, as high as 9500 feet, under rivers and through deserts.



Miles of railroad cars, thousands of trucks, trailers, and semi-tank trucks move finished products to distribution points, service stations, airports, marine stations, farms, factories and military installations. Standard either operates or leases nearly every form of transportation to keep vital oil supplies moving.

What's today's biggest travel bargain?—petroleum's trip from oil well to refinery to you, a journey that often covers thousands of miles by land, water and underground. To keep the "fare" low, Standard serves the Western hemisphere with a network of tankers, trucks, tank cars and pipelines.

They move oil in huge quantities carefully scheduled to match production at the well, refining capacity and our customers' needs. This far-flung transportation job is done at a cost so low it amounts to a fraction of the price per gallon—generally less than you pay to mail a postcard.

It's one way we work to keep down the price of the gasoline you buy.

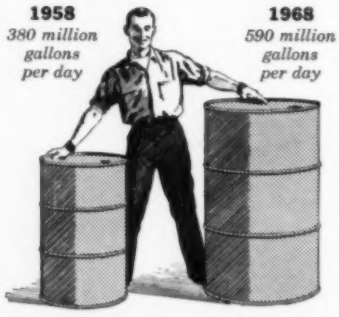
STANDARD OIL COMPANY OF CALIFORNIA
plans ahead to serve you better

Petroleum progress means...

Transportation to deliver the 55% more oil U.S. will use by 1968

1958
380 million gallons per day

1968
590 million gallons per day



FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

First transistor-powered mobile radios up to 60 watts

General Electric's Progress Line mobile radios now offer transistor advantages in all bands.

New transistorized power supply for both transmitters and receivers means no vibrators to replace, no rotating or vibrating parts to wear out. Transistors, plus high quality silicon rectifiers, give you the most dependable mobile communication known today.

Progress Line mobile radios with transistorized power supplies are available in *all* communication bands: 30 or 60 watts in low band (25-54 mc), 25 or 50 watts in high band (144-174 mc), or 15 watts in UHF band (450-470 mc).

OPERATE FROM EITHER BATTERY POLARITY—Only General Electric's Progress Line lets you operate on either positively or negatively grounded 12 volt batteries. This is especially important in fleet operations.

IMPROVED RANGE—Vibrator hash usually associated with receivers is totally eliminated by the use of transistors. The result is maximum receiver sensitivity.

NOT DAMAGED BY VOLTAGE VARIATIONS—Unlike vibrators, transistorized power supplies can withstand battery voltage variations from +20 to −50 percent.

PROGRESS WITHOUT OBSOLESCENCE—No need to buy new power cable or control head. General Electric Progress Line mobile units with either new transistorized power supply or regular vibrator power supply are *completely interchangeable.*

Call your G-E communications consultant for full details. He's listed under "Radio Communication Equipment" in the Yellow Pages. Or write General Electric Company, Communication Products Department, Section 3148, Syracuse, N. Y.

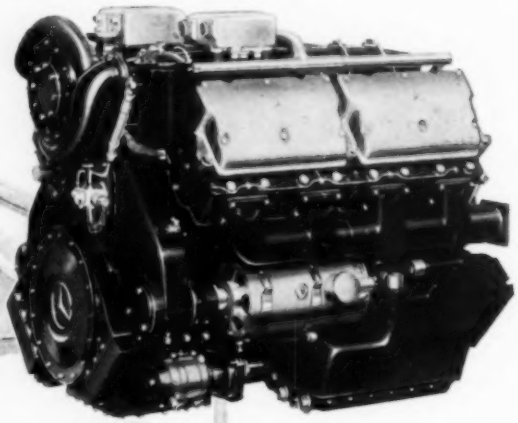
Progress Is Our Most Important Product

GENERAL ELECTRIC

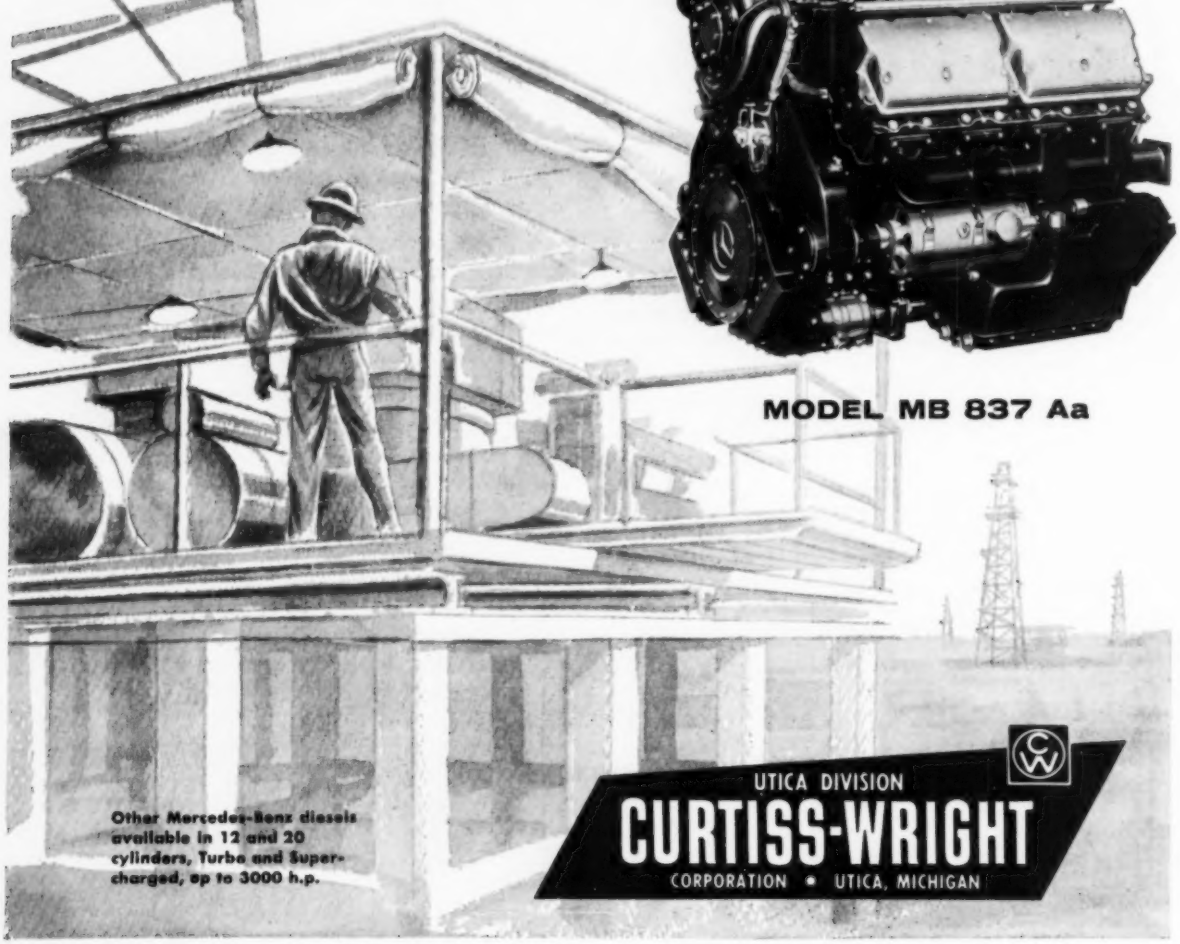
EFFORTLESS PERFORMANCE FROM START TO FINISH

MERCEDES-BENZ
DIESEL ENGINES

Mercedes-Benz diesel engines are powered to meet the toughest requirements of the petroleum industry—both inshore and offshore operations . . . They are designed and built to provide low-cost power for rugged, deep drilling, pumping, electrical generating and innumerable other specialized applications . . . High horsepower to weight ratio and compact size permit room for other rig equipment . . . Their unusually long engine life and exclusive Mercedes-Benz design allow continuous operation under extreme climatic conditions . . . Your Mercedes-Benz dealer can supply you with complete information on the full range of models from 36 to 3000 h.p.



MODEL MB 837 Aa



Other Mercedes-Benz diesels available in 12 and 20 cylinders, Turbo and Supercharged, up to 3000 h.p.

UTICA DIVISION
CURTISS-WRIGHT
CORPORATION • UTICA, MICHIGAN

seventh of a series

University of Pittsburgh calls its professional development course . . .

Executives have coffee break.

Management Problems for Executives

Given twice a year for an 8-week period, program has had nearly a 1000 attendance in its 18 years

C. L. Van Sickle

THIS professional executive development course, at the University of Pittsburgh, was the second policy type course to be offered by a university in this country. It was inaugurated in the spring of 1949, and 18 sessions have been completed. The 990 business executives selected for this course have attended the first 18 sessions. Their average age was 42. They have come from 38 states, the District of Columbia, the Territory of Hawaii, and 40 foreign countries. They represented 205 organizations in 53 private industries and numerous Federal government agencies.

The course was initially sponsored by the education committee of the Pittsburgh Chamber of Commerce to satisfy the need for executive development in the Pittsburgh area. Popularity of the course, however, soon spread nationwide and internationally.

This course was designed and is still presented and operated for the benefit of executives principally at the upper level of middle management.

There are no specific educational prerequisites for the course. Qualifications for admission are that the applicant must have demonstrated in his business career qualities of ability, leadership, and adaptability, and have had at least 15 years of business experience.

A thorough integration of the subject matter in the curriculum permits the achievement of the objectives of the course which are:

1. *To aid in developing the ability of the participant to think and act in the interest of business as a whole.*

2. *To broaden the vision of the participant beyond the departmental areas in which he is working and interest him in all of the aspects of management that are essential to successful business operation.*

3. *To emphasize the importance of human relations and leaderships in organizations.*

4. *To develop an understanding of the influence of the broad social, economic, and political factors within which business must operate today.*

The course is divided into three major management areas: (1) Business policy, (2) operating and administrative policies, (3) management controls.

The second division includes the subjects of administrative practices and human relations, marketing policies, financial policies, industrial relations and business and government. The third division embodies accounting analyses and controls, and industrial management. The entire course is coordinated and integrated through the subjects of business policy and administrative practices so as to simulate operations and activities in going organizations.

All subject matter is presented at a policy level and techniques are avoided. Reading assignments, lectures, and class discussions are followed the first two weeks of the course so as to present the basic principles and terminology of each subject. Thereafter cases are incorporated in most of the subjects and the conference method of instruction is used toward the end of showing how decisions are made and administered by executives.

A full resident faculty divides its time between this course and graduate work in the School of Business Administration. They guide members' discussions in management subjects so that the classroom activities simulate actual business situations of going enterprises.

Executives of business concerns appear as special guest speakers in each session. Visitations are also made to plants of leading industries in the Pittsburgh district.

Members of the course reside at Hotel Webster Hall, which is adjacent to the Cathedral of Learning where the classes are conducted. Meals may be had at either the hotel, at the Faculty Club, or at other restaurants in the vicinity of the University.

The course is of eight weeks duration. It is offered each fall and spring. The nineteenth session will run from September 23 through November 15, 1957. The twentieth session will operate from March 10 through May 2, 1958.

Fee for the course is $1400, payable in advance after the application has been accepted. The fee covers tuition, books, supplies, field trip transportation, double room occupancy, and all other incidentals except meals and commencement day activities.

Applications should be addressed to C. L. Van Sickle, Director, Management Problems for Executives, University of Pittsburgh, Pittsburgh 13, Pennsylvania. ★ ★ ★

FIGHT Fat and Fatigue

Noted medical research director tells you how to handle your health. You can prevent heart disease by following two rules

Louis N. Katz

NINETY percent of the deaths that result from heart disease today come from or are associated with hardening of the arteries and high blood pressure. And, since half the deaths from all causes come from heart disease, this means that hypertension and arteriosclerosis — in one form or another — are responsible for some 45 percent of our fatalities.

Yet we really do not know what causes high blood pressure. We have done much research on it in the years past. But I'm not at all sure we are a great deal closer to understanding its causes than we were 30 or 40 years ago. The situation is better as regards the causes of artery hardening.

At least we do know something about the cure of the latter. As a matter of fact, we know a great deal about the cure — or rather about the cure-in-advance — prevention.

There can be no doubt now that diet has much to do with causing heart disease. Let me repeat — *NO DOUBT*.

1. Watch Your Diet

Doctors may differ among themselves on the exact role of some particular thing — a particular fat, for example. But there is no room for difference about the vital importance of diet itself.

We are living, quite literally, off the fat of the land in this nation — and the fat is killing us.

Laboratory experiments on animals of various kinds — chickens, rabbits, monkeys, dogs — have shown a definite link between a high-fat diet and heart trouble.

Statistics from the insurance companies, mortality tables show strikingly the grave dangers of being overweight.

Observation in the field has reinforced the conclusion. The experience of the people of Norway during the privations of the Nazi occupation; that of the men and women in concentration camps in Germany and Russia; that of Japanese prisoners of war in the last years of World War II — all of these show the tremendous importance of diet.

In each of these instances the people were forced to live under conditions of terrific strain. Because necessity compelled a low concentration of fats in their diets, however, they suffered much less heart disease than people do in what we would consider more normal circumstances. Austerity serves its purposes.

No nation in the world has a diet so high in fats as ours. It is bad enough in our day-to-day living. It becomes worse at times of conventions, when men live very high on the hog indeed. We are, on the average, taking 50 percent of our total calories as fats. We should, for health's sake be taking in only 25 to 30 percent at the most.

If you want to keep heart disease at arm's length, then, the first rule is simple: Watch your diet and the weight that the diet produces. Avoid the empty calories — things like certain sugars and "refined" breads — and keep fats in proper proportions. Eat a balanced diet.

This precept I can back up with detailed, conclusive evidence. The experiments, the statistics are there to support the advice.

2. Take It Easy

But a second precept rests, so far, on simple common sense. And that is to avoid unnecessary tension, unhealthy strain. Live a little, as they say — and you will live longer.

We try too hard, work too long, push too hard. Like a flock of the foolish chickens in my laboratory, we put too great an emphasis on position in the pecking order. And because we do these things, we put too great a burden on our heart and our circulatory system. So we die before our time.

It is essential that each of us learn to let up. Relax at least occasionally. Get some pleasant exercise without trying to become a competitive athlete. Skip the struggle for the main chance and strive a little for peace of mind and vigor of body.

These are principles for personal conduct if you have any regard at all for your heart and your job. They are principles, too, that should guide senior executives in the care and feeding of those who work for them.

Too many of us take as gospel that definition that holds that a good executive is a man who goes around with a worried look on the face of his assistant. We think it is necessary, not just to push ourselves, but to drive those who are our subordinates. We create situations of competitive rivalry if none exists naturally.

It is a bad practice. You ought at least to give it up for reasons of economics: It just doesn't make good business sense to spend a lot of money on the development of junior executives and then destroy the investment by killing them off young.

There are the two cautions that I would give to anyone who would protect his heart while he works at his job: Eat wisely and not too richly. Remember that easy does it and that too great a pressure can kill. ★ ★ ★

Louis N. Katz is a director of Cardiovascular Research, Michael Reese Hospital, Chicago, Illinois.

Taken from a paper presented to a Medical and Health Session at meeting of American Petroleum Institute, November 11, 1957, entitled "Your Heart — Your Job."

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LIGHT WEIGHT FITTINGS for lower-cost piping

Light weight piping makes practical the use of larger pipe for greater flow area, and it cuts cost and weight. To enable you to take full advantage of the economies of "thin wall" steel piping, Tube Turns offers a complete line of light weight fittings. TUBE-TURN* Light Weight Welding Fittings are produced under the same exacting quality control standards as the 12,000 other items in the Tube Turns' line. They are available promptly from your nearby Tube Turns' Distributor.

(*continued on next page*)

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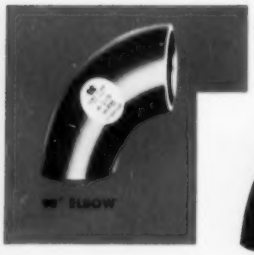
A typical user of light weight steel piping reports these benefits: 100 feet of 8" x .188" wall pipe costs about $10 less than 100 feet of 6" standard weight pipe • Increases flow area 85% • Cuts piping weight about 10% • To enable you to take full advantage of these economies, Tube Turns offers a complete line of light weight fittings. They are forged from seamless pipe. Meet all code requirements. Uniform wall thickness and true circularity permit field cutting of odd angles. Available promptly from Tube Turns' Distributors in all principal cities. Complete details in Bulletin TT 867, free on request.

The trademarks "tt" and "TUBE-TURN" are applicable only to the quality products of Tube Turns.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The Trade PARADE

Two New Stores Opened

The National Supply Company has opened two new oil field supply stores and modernized another. New stores are at Charlson, North Dakota, and near Leeville, Louisiana. William S. Dagg is manager in the North Dakota area. The store is supervised by J. D. McClintick, district manager of the company's Montana district. The Leeville store, on Highway No. 1, between Golden Meadow and Grand Isle, will serve land and offshore operators. Leroy W. Snell Jr., is store manager, under supervision of L. A. J. Monroe, district manager, New Orleans.

National Supply completely modernized its store in Oklahoma City, in use since 1929. The building was remodeled under the company's modernization program, according to plans by Henry Dreyfuss, noted industrial designer.

Wayne Showalter is store manager, under supervision of W. M. Jones, Oklahoma City district manager.

Offices of National's northwest division were moved to new and enlarged headquarters in the First National Bank Building, Denver. Robert D. Stottlemeyer is division manager. The division directs the company's oil field supply activities in Colorado, Idaho, Montana, North Dakota, South Dakota, Utah, Wyoming, and parts of Nebraska and New Mexico.

No Complaints Here

Recently moved to its new and larger facilities at 7430 Katy Road, OTM Corporation is already planning expansion of its 3½ acres under roof. Not following the proclaimed trend OTM has had a remarkable sales increase.

January was 35 percent ahead of December, which was the most prosperous the company ever had. Employees received a 5 percent pay hike in January. The company makes flanges for pipelines and refineries.

Dresser A. G. Expands

Reece Hatchitt, president of Dresser A. G., European affiliate of Dresser Industries, Inc., announces expansion of the SIE Division. SIE (Southwestern Industrial Electronics) is a manufacturer of electronic equipment and instrument systems.

Chris Ring, formerly with SIE of Houston, Texas, has been appointed manager of the division. William N. Reese, also formerly with the Houston company, has been placed in charge of technical services.

PETROLEUM EQUIPMENT SUPPLIERS Association, Pacific District, will meet Thursday, April 17, at Beverly Hilton Hotel, Los Angeles, California.

R. F. Faul, vice president, California Research Corporation, the guest speaker, will talk on research possibilities of small corporations in the oil industry, W. A. Wilson, chairman announced.

Grover Kilgore, national president; W. T. Powell, vice president, and H. R. Safford, Jr., executive secretary, will be present.

MAGNET COVE BARIUM Corporation, Houston, one of the Dresser Industries, has acquired Mud Supply Company, Inc., a Magcobar distributor in Louisiana headquartered at Lake Charles. There will be no change in company policy or personnel, and I. W. Hoskins will continue as Mud Supply's president and general manager.

DRILLING EQUIPMENT manufactured by Unit Rig and Equipment Company hereafter will be sold by Mid-Continent Supply Company and will carry the Mid-Continent name. There will be no changes in the manufacturing division of Unit but distribution through the Mid-Continent's system will be stepped up in the United States, Canada and South America.

Changes in Venezuela

BS&B International, S.A., a wholly-owned subsidiary of Black, Sivalls & Bryson, Inc., established a Venezuelan Division with offices at Caracas, Maracaibo and Anaco, according to Kenneth W. Lineberry, president. Allen Pike, formerly of Oilfield Sales and Service, S.A., exclusive representatives for BS&B oilfield equipment in Venezuela since 1952, is manager of the newly-created division with headquarters at Caracas. Prior to his association with Oilfield Sales and Service and BS&B, Pike was with the production department of the Mene Grande Oil Company at Caracas. James H. Clayton is branch manager at Maracaibo which will serve Western Venezuela.

Rector Well Equipment Company, in Venezuela, named Irwin B. Allen representative. Allen has been in Venezuela for the past 10 years and was formerly president of Peticon.

Equipo Petrolero Compania Anonima, a new enterprise, has begun operations in Venezuela. Principal officers of EPECA include Robert E. Murphy, president; Ed T. Malloy, executive vice president; and Lamar W. Davis, Jr., vice president in charge of engineering. Murphy and Malloy are also associated with the Levingston Shipbuilding Company at Orange, Texas, which will operate a new shipyard, now under construction in Maracaibo, known as VAZCA; Lamar W. Davis, Jr., is a consulting petroleum engineer from Houston, Texas.

EPECA will engage in the sales and service of Harold Brown Company gas-lift equipment.

HOMCO has formed a Venezuela subsidiary, HOMCO International, C.A. An office has been opened in Maracaibo and complete office and warehouse facilities are being constructed at nearby Las Morochas. A. F. Coleman, operations manager, is stationed in Maracaibo.

JOHN P. REEVES & Company, corrosion engineers of Salt Lake City, were appointed exclusive representative in Utah, Montana and Idaho, of T. D. Williamson, Inc. Before organizing his own company in 1954, Reeves was associated with Kennecott Copper Corporation.

At ground breaking ceremonies of an addition to the new engineering building of Continental-Emsco Company in Houston, Texas, F. M. Mayer, president, digs in. Shown are: Walter Rolfe, Goleman and Rolfe Architects; Joe Humans, president, Southwest Construction Company; S. A. Martin, plant manager, Continental-Emsco, Houston; Mr. Mayer; W. T. Powell, executive vice president — manufacturing; R. Hortenstine, Jr., vice president in charge of Gulf Coast Division, and J. D. Mihalick, purchasing agent, Houston.

Honored for 30-year service. William L. Butler, right, president of W. C. Norris, Manufacturer, Tulsa, Oklahoma, presents at a recent employee meeting wrist watches to Kyle E. Reynolds, John W. Powers, Raymond P. Engles and Raymond E. Gordon (left to right), honoring their 30 years' service with company. Lapel pins for 25 years were presented to Terry D. Griggs and Mack H. Seay.

INDUSTRIAL SILENCER DIVISION of Burgess-Manning Company, Libertyville, Illinois, and Dallas, Texas, held its annual sales conference in Fort Worth. S. G. Paddock, Executive Vice-President discussed the broadening market for industrial silencers, for the intake and exhaust of internal combustion engines, compressors, etc., and pulsation in gas pipe line systems. Volume of business was cited as evidence of the trend toward elimination of excessive noise.

Position _____

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NEW... for the first time...

A GUIDE TO HELP YOU SELECT BETTER UNIONS

Here's a 16-page HANDBOOK that gives facts and tells...

THE IMPORTANT THINGS YOU NEED TO KNOW ABOUT UNIONS

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The high points of this wealth of practical experience provide a liberal education in unions for contractors, piping superintendents, steam-fitters, maintenance men, and purchasing agents. "What Makes a Good Union" is a trouble-shooter's handbook and an excellent text book for training new men.

BE SURE TO WRITE FOR YOUR *FREE* COPY OF "What Makes a Good Union" so you'll have at your fingertips the useful, money-saving information contained in this easy-to-understand handbook.

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Beckman Instruments, Inc. Dr. Edward G. Pickels was appointed acting manager of Spinco division, Palo Alto, California. He assumes division managership from Maurice C. Hanafin, who was named manager of Shockley Semiconductor Laboratory of Palo Alto and Mountain View, California. Dr. Pickels will continue as director of research for the Spinco division.

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Byron Jackson Tools, Inc. J. P. Magoffin was appointed European sales manager. The new post was created to facilitate sales of all BJ oil field equipment — including cementing and fracturing units and PB rubber products — and to bring about a closer, more personalized relationship between the company and its customers in Europe and the Middle East.

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▸ **Ethyl Corporation.** W. K. McCullough was named assistant to the vice president in charge of sales, a newly created position. Associated with Ethyl since 1932, he has been engaged in the sales, advertising and sales promotion activities of the company throughout his entire career.

▸ **Drilco Oil Tools, Inc.** Glen Chance was appointed representative for the Ark-La-Tex district. He was formerly with Baash Ross, Republic Supply, and served three years as sales and service representative with Lee C. Moore. Chance will be in the Shreveport area.

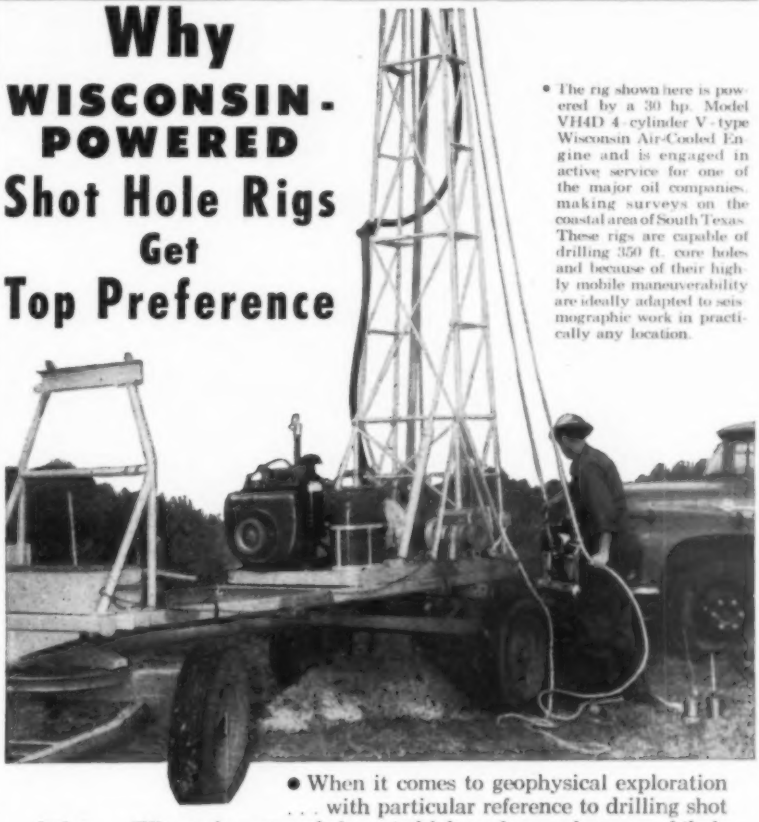
▸ **Dresser Industries, Inc.** John T. Dunton and Howard Hoke have been appointed engineering managers in charge of pipe joining products and service fittings, and pipe repair products respectively, in the newly organized product engineering department, Manufacturing division, Bradford, Pennsylvania. They will initiate, develop and operate a program for new product design and improvement of existing products. Newly appointed customer service engineer, Thomas O'Hargan, will be responsible for investigating and evaluating customer's requests for regular product adaptations. It is planned to have eleven such product management groups under engineering managers. C. E. Boston and William J. C. Marshall, Jr. were appointed general markets sales representatives for Northern California and Western Nevada, and for the New England states, respectively by Manufacturing Division, Bradford. Milton H. Nelson was advanced from controller to treasurer of Manufacturing division. Gordon E. Mott was promoted from assistant to general manager of finance to controller.

▸ **John A. Roebling's Sons Corporation.** William C. Ridge has been elected vice president-production of this subsidiary of Colorado Fuel and Iron. Prior to his appointment, he was works manager.

▸ **Hercules Tool Company.** Walter H. Cox was advanced to sales manager. He joined the company in 1955 as city salesman. Prior to that, he was with Oil Well Supply for 18 years, later with Kerotest Valve, then L. C. Moore. L. C. (Dusty) Rhoads, vice president and former sales manager, has continued to perform the functions of sales manager since his appointment to vice president.

▸ **W. C. Norris, Manufacturer.** Added to sales staff of this division of Dover Corporation, Tulsa, Oklahoma are: Homer Hill, now at Ardmore; Jack Connell, Houston Texas; Barron Preslar, who succeeded Jack Getty at Shreveport upon Getty's advance to the Tulsa office; George White, Hobbs, New Mexico; Earl Carpenter, northern Oklahoma and Kansas.

Why WISCONSIN-POWERED Shot Hole Rigs Get Top Preference



• The rig shown here is powered by a 30 hp. Model VH4D 4-cylinder V-type Wisconsin Air-Cooled Engine and is engaged in active service for one of the major oil companies, making surveys on the coastal area of South Texas. These rigs are capable of drilling 350 ft. core holes and because of their highly mobile maneuverability are ideally adapted to seismographic work in practically any location.

• When it comes to geophysical exploration . . . with particular reference to drilling shot holes . . . Wisconsin-powered rigs rate high preference because of their heavy-duty dependability, relatively light weight, simplicity of operation and servicing, High Torque Performance characteristics and all-weather AIR-COOLING.

The Wisconsin Engine will keep slugging away in any climate, in any weather, at temperatures ranging from low sub-zero to 140° F. Trouble-free AIR-COOLING makes the difference! And when it comes to serviceability, Stellite exhaust valves and valve-seat inserts, in combination with positive-type valve rotators, increase valve life up to 500% . . . with a comparable reduction in servicing.

If you have a power job within a 3 to 56 hp. range, let a Wisconsin Heavy-Duty Air-Cooled Engine handle it. Write for Engine Bulletin S-223.

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Ethyl Corporation. W. K. McCullough was named assistant to the vice president in charge of sales, a newly created position. Associated with Ethyl since 1932, he has been engaged in the sales, advertising and sales promotion activities of the company throughout his entire career.

Drilco Oil Tools, Inc. Glen Chance was appointed representative for the Ark-La-Tex district. He was formerly with Baash Ross, Republic Supply, and served three years as sales and service representative with Lee C. Moore. Chance will be in the Shreveport area.

Dresser Industries, Inc. John T. Dunton and Howard Hoke have been appointed engineering managers in charge of pipe joining products and service fittings, and pipe repair products respectively, in the newly organized product engineering department, Manufacturing division, Bradford, Pennsylvania. They will initiate, develop and operate a program for new product design and improvement of existing products. Newly appointed customer service engineer, Thomas O'Hargan, will be responsible for investigating and evaluating customer's requests for regular product adaptations. It is planned to have eleven such product management groups under engineering managers. C. E. Boston and William J. C. Marshall, Jr. were appointed general markets sales representatives for Northern California and Western Nevada, and for the New England states, respectively by Manufacturing Division, Bradford. Milton H. Nelson was advanced from controller to treasurer of Manufacturing division. Gordon E. Mott was promoted from assistant to general manager of finance to controller.

John A. Roebling's Sons Corporation. William C. Ridge has been elected vice president-production of this subsidiary of Colorado Fuel and Iron. Prior to his appointment, he was works manager.

Hercules Tool Company. Walter H. Cox was advanced to sales manager. He joined the company in 1955 as city salesman. Prior to that, he was with Oil Well Supply for 18 years, later with Kerotest Valve, then L. C. Moore. L. C. (Dusty) Rhoads, vice president and former sales manager, has continued to perform the functions of sales manager since his appointment to vice president.

W. C. Norris, Manufacturer. Added to sales staff of this division of Dover Corporation, Tulsa, Oklahoma are: Homer Hill, now at Ardmore; Jack Connell, Houston Texas; Barron Preslar, who succeeded Jack Getty at Shreveport upon Getty's advance to the Tulsa office; George White, Hobbs, New Mexico; Earl Carpenter, northern Oklahoma and Kansas.

Why WISCONSIN-POWERED Shot Hole Rigs Get Top Preference

• The rig shown here is powered by a 30 hp. Model VH4D 4-cylinder V-type Wisconsin Air-Cooled Engine and is engaged in active service for one of the major oil companies, making surveys on the coastal area of South Texas. These rigs are capable of drilling 350 ft. core holes and because of their highly mobile maneuverability are ideally adapted to seismographic work in practically any location.

• When it comes to geophysical exploration . . . with particular reference to drilling shot holes . . . Wisconsin-powered rigs rate high preference because of their heavy-duty dependability, relatively light weight, simplicity of operation and servicing, High Torque Performance characteristics and all-weather AIR-COOLING.

The Wisconsin Engine will keep slugging away in any climate, in any weather, at temperatures ranging from low sub-zero to 140° F. Trouble-free AIR-COOLING makes the difference! And when it comes to serviceability, Stellite exhaust valves and valve-seat inserts, in combination with positive-type valve rotators, increase valve life up to 500% . . . with a comparable reduction in servicing.

If you have a power job within a 3 to 56 hp. range, let a Wisconsin Heavy-Duty Air-Cooled Engine handle it. Write for Engine Bulletin S-223.

WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

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OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS

A8-6177

$$Ca^{++} + Na_2Z = CaZ + 2Na^{+}$$

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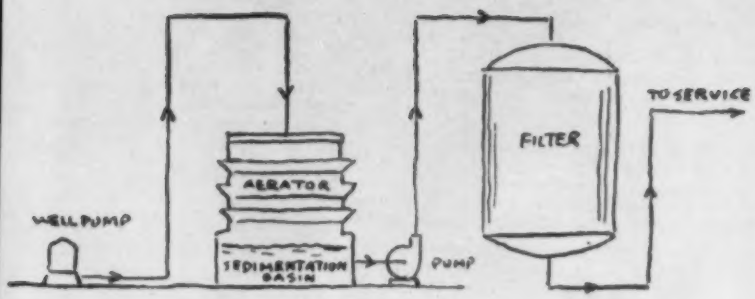
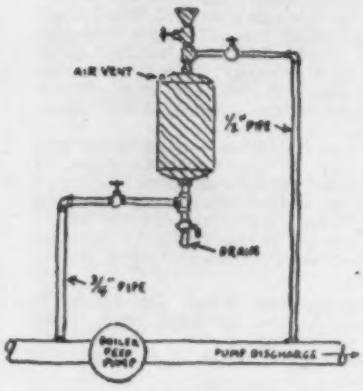




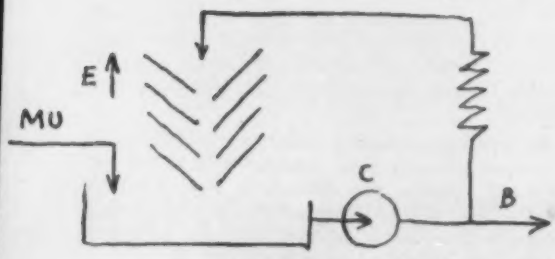
$$V = \frac{18.5D^2(S_1 - S_2)}{Z}$$

$$\frac{x}{m} = KC^{1/n}$$

any way you figure it,

the best solution to your

water problems is . . .



BETZ LABORATORIES INC., Philadelphia 24, Pa.

OILFIELD EQUIPMENT and steel products manufacturer, Black, Sivalls & Bryson, Inc., has been licensed to build and sell oilfield lease automation systems under patents held by Shell Development Company, subsidiary of Shell Oil Company. In addition, arrangements have been completed for transmittal to BS&B all of Shell's technical information pertaining to oilfield automation systems.

Both companies have been active for years in the development and research of oil well lease automation, which provides automatic control and remote operation of oil and gas producing fields.

MID-CONTINENT SUPPLY Company will be world-wide (except Mexico) exclusive distributor of the oil field equipment products of Delta Tank Manufacturing Company of Baton Rouge, Louisiana. This recent joint announcement was made by President Ken W. Davis of Mid-Continent and President Hal S. Phillips of Delta Tank. Agreement covers sales and service to the export, domestic and Canadian markets.

L. W. MACNAUGHTON was elected to the board of Dresser Industries, Inc. He is board chairman for the consulting firm of DeGolyer and MacNaughton, of which he was one of the co-founders.

MacNaughton has contributed a great deal to advances in several fields of the petroleum industry. He has personally been responsible for a considerable amount of study and literature on oil and gas production, geology, and economics.

GRANT OIL TOOL Company is now occupying its new Los Angeles offices and production facilities at 2042 East Vernon Avenue. The new plant, which covers 20,000 square feet, is another step in Grant Oil Tool's expansion program.

MORE THAN FORTY oil field sales representatives from offices throughout the United States, Canada and South America were in Lufkin for the annual conference of Lufkin Foundry & Machine Company. L. A. Little, vice president of the company, opened the conference.

Included on the program was study of recent developments in the Lufkin line of oil field machinery and equipment, gears, etc. Problems facing the oil industry throughout the world were discussed by sales representatives and plant personnel.

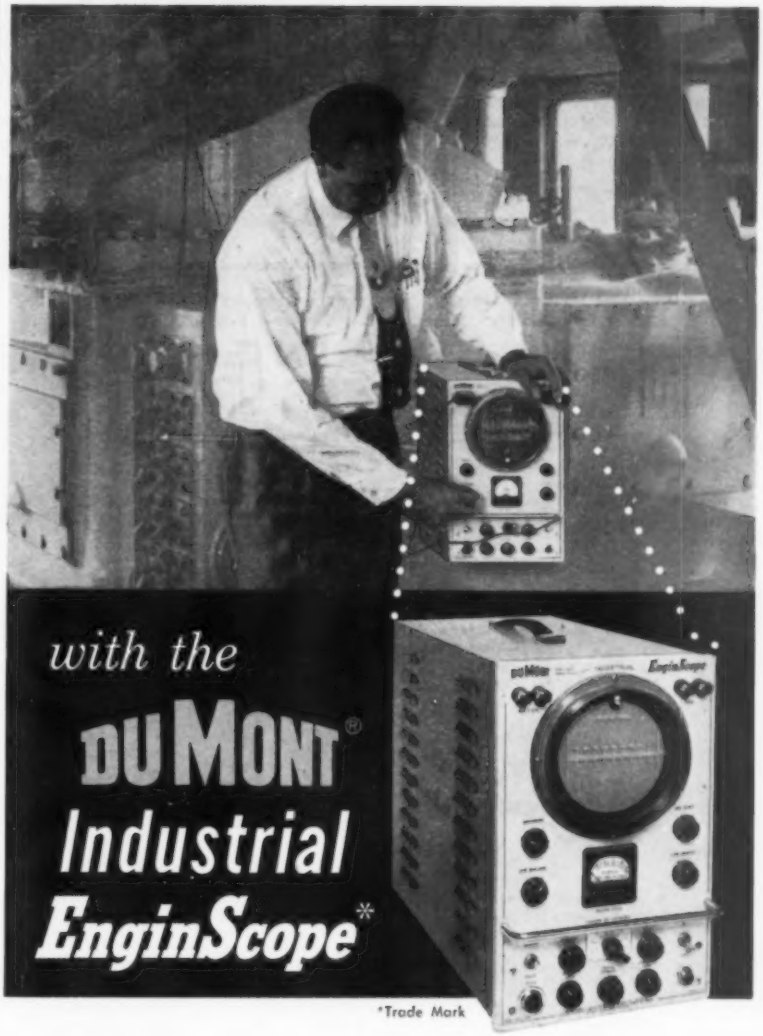
PEOPLE

▸ **Globe Oil Tools Company.** John V. Pennington was elected vice president and general manager. An honor graduate from the Stevens Institute of Technology, he received his Doctorate in Physics from the graduate school of Rice Institute, advanced studies in Mechanical Engineering and mathematics. After his first engineering assignments on the East Coast, "Doc" went to Houston where he was introduced to the rock bit business, serving for 13 years with one manufacturer.

▸ **Orbit Valve Company.** Arthur J. Burk is new representative in Wichita Falls, Texas. David M. Alkire was transferred from Wichita Falls to Casper, Wyoming, and Owen H. Walker from Houston, Texas, to New Orleans, Louisiana.

▸ **Nordberg Manufacturing Company.** H. W. "Herb" Dow, Jr. is new manager, New York district office, engine division. He succeeds A. R. McMullin, retired, after serving as manager since 1936.

assure top efficiency and minimum down-time...



*Trade Mark

Instantaneous, dynamic analysis of total performance provides information that greatly simplifies both routine and emergency service of low-speed, industrial spark-ignited engines.

The famous Du Mont EnginScope that is making history in the automotive service field is now available in a **special model** specifically intended for the industrial engine field. The Industrial EnginScope analyzes through the **secondary** ignition voltage, thus accurately indicating conditions at the actual ignition point of the engine.

★ **Connects to engine while running.**

★ **Assures top operating efficiency of engine.**

★ **Reduces routine maintenance costs.**

★ **Reduces down-time by "forecasting" faults.**

★ **Easily used by technical, or non-technical personnel.**

Write for complete details . . .

Dept. PE4
Automotive Equipment Division
ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

Jefferson Chemical Company, Inc. Named to two product manager posts recently created were Joseph K. Goerner as manager, Specialty Products, and Ben C. Hayton as manager, Glycol Products. Both men will report to D. L. Griswold, general manager of the company's marketing department.

Bethlehem Supply Company. Denver district sales office has been made a division sales office. L. V. Nowlin, former local representative at the Dallas, Texas division sales office, was promoted to resident sales manager in charge of the new Denver office. W. A. Nestlerode is now special division sales representative on machinery and waterflood projects and H. B. Karstetter is division sales representative, assisting Nowlin

Jones & Laughlin Supply Division. D. T. Ottinger, formerly district sales manager of the South Texas District, is manager of a new region, the Gulf Coast with headquarters at Houston, Texas. F. L. McFarland, formerly district manager, West Texas, was appointed regional manager for the new Southwest region with headquarters at Midland. D. H. Carson is the third new regional manager of the Rocky Mountains with headquarters at Denver, Colorado.

New assignments include: R. E. Holbrook, formerly local store manager at Lafayette was transferred to Houston, Texas store in the same capacity; B. M. Ferriss was promoted to local store manager at Lafayette, Louisiana.

L. K. Greer was assigned as a salesman at Borger, Texas store; D. R. McKown to Williston, North Dakota, store as a salesman; J. W. Payne as a salesman to Lindsay, Oklahoma store; J. N. Ryan, as salesman to Laurel, Mississippi store; H. L. Shackelford as salesman to Odessa, Texas store; C. H. Warren, Jr., as salesman to Sundown, Texas; D. R. Williams, salesman to Snyder, Texas; C. S. Wood, salesman to Odessa.

New District sales managers are: L. P. Mackey, for South Texas district at Houston; H. H. Ray, for Central Texas district at Abilene; G. A. Whitaker, for West Texas-New Mexico district at Odessa; J. W. Johnson, for Southern Rocky Mountain district at Farmington, New Mexico; G. E. Best, for Central Rocky Mountain district at Casper, Wyoming.

Worthington Corporation. William F. Weinreich, works manager, was made general manager of Oil City, Pennsylvania works, recently reorganized as the Oil City division. Continuing as manager of sales for mechanical power transmission products is Draper E. Tessendorf. R. Kenneth Grobholz will continue as manager of sales for power pumps.

Petrolite Corporation. Glenn W. Camblin, vice president of Petrolite Corporation and general manager of its Tretolite Company of California Division since it was established in Los Angeles in 1930, has retired after more than 33 years of service in the Tretolite organization. He will be succeeded by Louis T. Monson, presently chief chemist of the division and a 32-year man.

Charles D. Krieg of Tretolite division of Petrolite service and development laboratory in St. Louis, Missouri, has been assigned to Houston, Texas to carry on liaison work of field to the central research and development program.

He succeeds Ed A. Baumstark, who recently was appointed assistant to L. A. Bainter, Jr., manager of the Southern division.

Otis Engineering Corporation. Herbert C. Otis, Jr., first vice president, has been elected chief of the Dallas Emergency Corps. The organization is a volunteer group formed to assist local law enforcement agencies, fire departments, and similar organizations in Dallas.

Rockwell Manufacturing Company. Two key Rockwell sales officials have been promoted to newly created sales management posts in the expanding International Division. Nelson E. Davenport, assistant to vice president of sales, Meter and Valve Division, was named export sales manager-meter and valve products. Walter G. George, who joined Rockwell in March, 1957, as assistant export manager-Delta power tools, is the new export sales manager-power tools and municipal products.

Rowland B. Drescher, formerly Pittsburgh district manager, has been named assistant sales manager of Republic Flow Meters Company, a subsidiary. In addition to his sales duties, he will supervise the engineering of contracts placed with Republic.

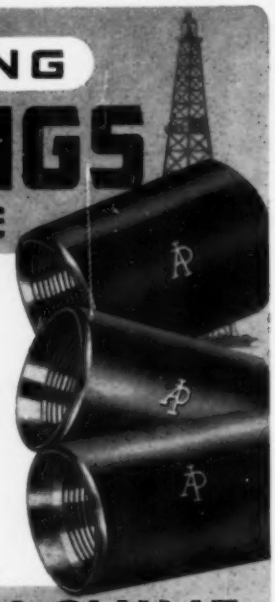
Alfred C. Wenzel formerly chief project engineer has been named production manager of Republic Flow Meters. He will be responsible for all manufacturing and production control operations in the two Chicago plants.

Caterpillar Tractor Company. William Blackie, executive vice president, has been elected a director of the company to succeed Murray M. Baker, resigned after 30 years as a director.

WHEELING

COUPLINGS

FOR OIL COUNTRY USE



LINE PIPE COUPLINGS A. P. I.
1/8" to 12" — Seamless and Special Processed — Black or Galvanized

PLAIN TUBING COUPLINGS A. P. I.
1" to 4" — Seamless

EXTERNAL UPSET TUBING COUPLINGS A. P. I.
1¼" to 3½" — Seamless

CASING COUPLINGS A. P. I.
4½" to 13⅜" — Long or Short

HYDRAULIC COUPLINGS
1/8" to 4" — Seamless

REAMED AND DRIFTED A. I. S. I.
¾" to 12" — Seamless

DRIVE PIPE COUPLINGS
6" to 12" — Seamless

WHEELING MACHINE PRODUCTS COMPANY

WHEELING, WEST VIRGINIA

WEST COAST FACTORY: WOODLAKE, CALIFORNIA

X

SALES OFFICES IN LEADING CITIES

Baltimore, Md. — James W. Frankhanel, 2301 N. Charles St.
Chicago, Ill. — Harry A. Jay, Suite 1090, Old Colony Bldg.
Denver, Colo. — W. G. Cline & Co., 4500 Kalamath
Detroit, Mich. — R. W. Lang, Jr., 505 Park Avenue
Erie, Pa. — R. J. Maggi, Box 711
Falmouth, Mass. — Walter S. Bennett, 53 Minot St.
Grand Rapids, Mich. — R. W. Lang, Jr., 138 Burton SE
Houston, Tex. — Henry H. Paris Distributor, Inc., Box 932
Independence, Mo. — Craig A. Frost, 3701 Norwood
Los Angeles, Cal. — James A. Riordan Co., 1400 Santa Fe Ave.
Louisville, Ky. — Sid Schultze Co., 849 S. 6th St.
Milwaukee, Wisc. — W. G. Nelson Co., 3347 N. 97th St.
Narberth, Pa. — Worthington-Grothaus and Associates, 105 Forrest Ave
Newark, N. J. — Ira L. Rothenberg & Assocs., 398 Market St.
New York, N.Y. — Max Rothenberg, 11-05 38th Ave., Long Island City
Omaha, Nebr. — Wm. Freiden, Central States Engineering & Sales Co., 5101 Blondo St.
Oswego, N. Y. — Northeastern Associates, Neil Chatterton, Sec'y, P. O. Box 284
Portland, Ore. — J. G. Beard Co., 1233 NW 12th Ave.
Richmond, Va. — P. C. Abbott & Co., 15 E. Franklin St.
St. Louis, Mo. — Walter C. Dollinger Co., 4869 Goodfellow Ave.
Salt Lake City, Utah — Lovell Company, 29 E. 2nd St. South
Seattle, Wash. — Ashe & Jones, 819 Thomas St.

QUALITY-CONTROLLED PIPE COUPLINGS SINCE 1918

Armite Laboratories. S. A. "Si" Chesnutt is new sales manager of Armite, Los Angeles, California. He has served in technical sales area, with training in hydraulic engineering and industrial control, plus mechanical and electrical power transmission.

American Meter. Pierce W. Butler, Jr. has been named manager of the new plant in Wyalusing, Pennsylvania.

Allis-Chalmers Manufacturing Company. James C. Barnett has been named resident representative with new sales office at 412 First National Bank Building, Abilene, Texas. He was a sales representative in Dallas district office.

Charles N. Karr retired December 31, 1957 as sales promotion manager of the Tractor Group. He has held this position since 1945, directing advertising and sales promotional activities for construction machinery, engine-material handling and farm equipment divisions.

ALCO Products. E. J. Van Valkenburgh is director of a new procurement and materials service division. He will report to Perry T. Egbert, ALCO president.

American Cyanamid Company. Vice presidents, Kenneth H. Klipstein and George R. Martin, have been elected to the newly created office of executive vice president.

J. Ray Coulter was made manager of manufacturing of Industrial Chemicals division.

Ben F. Melucci was named commercial development manager of Industrial Chemicals division.

F. W. Davis has been named assistant manager of manufacturing for explosives for the Organic Chemicals division.

B. R. Putnam, Jr. was appointed manager of the petrochemicals department of Organic Chemicals division, New York.

George W. Hedden, Jr., was made assistant manager of manufacturing for the Organic Chemicals division, Bound Brook, New Jersey.

Continental-Emsco Company. Jack Amerman was promoted to chief engineer and Jack Eldridge to chief engineer mechanical. Virgil Clark is presently chief engineer of structural. All three men are at the oil field supply and manufacturing company's plant in Houston, Texas.

Cooper-Bessemer. Roy W. P. Johnson and Curt J. Havekotte were promoted to the respective positions of New York assistant district manager and branch manager.

Dowell Incorporated. J. P. Moran was transferred from Houston, Texas, to Tulsa, Oklahoma, where he will be reservoir engineer in the Chemical Research laboratory.

Notice was received from the Commissioner of Patents in Washington, D.C. that Charles L. Lunsford has passed all necessary tests to qualify as a patent agent.

Charles Noble, formerly of Tulsa, has been promoted to district engineer in the Rocky Mountain area. Don Torgerson is new station manager at Williston, North Dakota. He transferred from San Angelo, Texas. M. E. Heslep, sales engineer at Williston will now devote all his attention to sales in the active Williston area.

R. L. Dickson, who represented Dowell's general office sales department in Billings, Montana, was transferred to the Rocky Mountain district as sales engineer.

Ira Mumm, who has been at Vernal, Utah for several years, will have the title of station manager and supervise sales. L.V. Volkel, service engineer, was promoted to petroleum engineer. K. D. Henry, formerly of Victoria, Texas, was transferred to Vernal as service engineer.

M. J. Carney, formerly service engineer at Henderson, Kentucky, was transferred to Casper, Wyoming.

R. L. Mettle, service manager at Kimball, Nebraska, was promoted to station manager.

O. W. Mason, a service engineer was transferred to Sterling, Colorado from Worland, Wyoming. J. A. McClure was transferred from Williston Basin to Charleston, West Virginia.

E. A. Ernst, who joined Dowell as a clerk at Wichita Falls in 1945 is now district engineer. He succeeds J. A. Harmon, district engineer at New Orleans.

Consolidated Electrodynamics Corporation. Capt Frank C. Mansville, USN (Ret.), formerly administrative manager, was appointed manager of Transducer division's ceramic products department. Fred J. MacKenzie was named to succeed Manville as administrative manager.

Babcock & Wilcox. William W. Gilbert was appointed manager of the Detroit district sales office of boiler division. He succeeds Arthur R. Waugaman, who retired after 22 years of service.

Axelson Manufacturing Company. Lester G. Evans, formerly vice president and general manager of the All-Power Manufacturing comany, was appointed general sales manager. K. S. Ramey, former sales manager, has been promoted to assistant to the president, James F. Beré.

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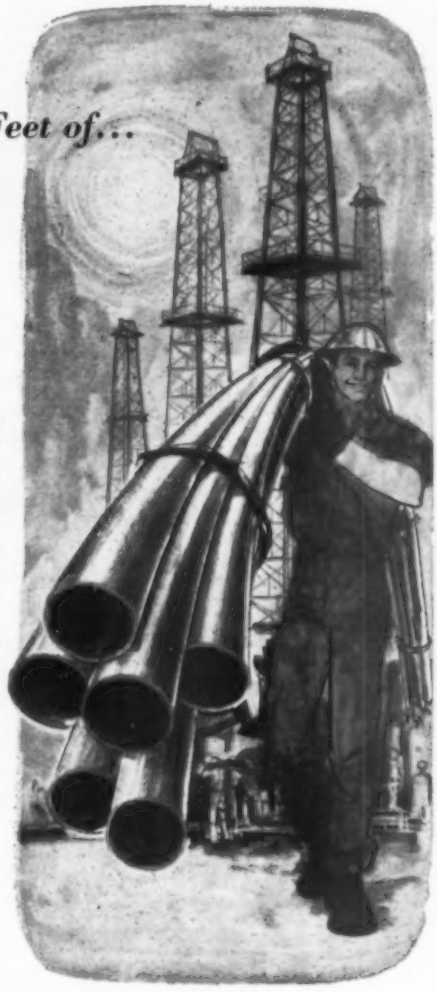
KRALOY

HIGH-IMPACT

PVC PIPE

in oil-country use today



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KRALOY is the most experienced manufacturer of PVC plastic pipe for the petroleum industry. The first polyvinyl chloride lead line installed in this country—at Great Bend, Kansas—was Kraloy Pipe. Kraloy High-Impact PVC today is preferred by production men for maintenance-free service in lead lines and disposal systems. Kraloy customers use Kraloy High-Impact PVC pipe for lead lines, gas lines, and salt water lines because Kraloy normally eliminates (1) sulphur corrosion due to sour crude, (2) paraffin buildup, (3) corrosion and scale, (4) trouble from soil electrolysis.

YOU Benefit From KRALOY'S Quality Control

To insure quality control, random samples of Kraloy Plastic Pipe are tested daily in Kraloy's own laboratory for burst pressure, impact resistance, and tensile strength under standard ASTM specifications.

Kraloy Pipe is Sold Only Through Qualified Supply Stores

Warehouse stocks and sales representatives:

Kraloy Export Office, 30 Rockefeller Plaza
N. Y. 20, N. Y.

John Piersol, 13913 Hillcrest Rd.
DALLAS 30, TEXAS

The Mack Company, 2005 Hackney St.
HOUSTON 23, TEXAS

Ross Howell, 209 E. Scott St.
WICHITA FALLS, TEXAS

The Becker Sales Company, P. O. Box 2262
TULSA, OKLAHOMA

The Becker Sales Company, 716 S. 29th St.
OKLAHOMA CITY, OKLAHOMA

Robinson Oil Field Specialties, 616 Main St.
GREAT BEND, KANSAS

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Subsidiary of the Seamless Rubber Co., a **Rexall Drug Co.** Subsidiary

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MID-CONTINENT SUPPLY COMPANY

EXCLUSIVE DISTRIBUTOR WORLD WIDE*

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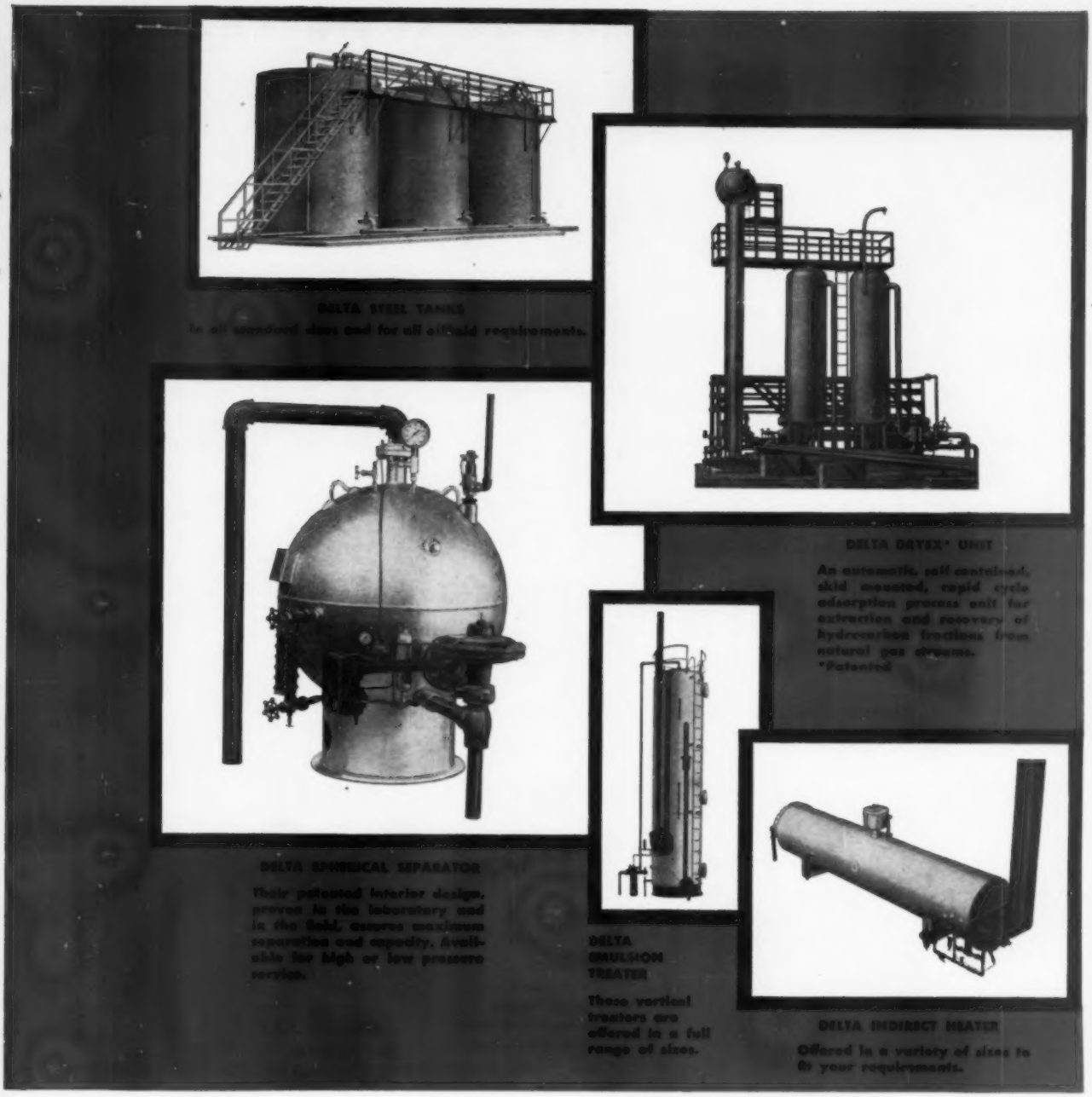
MID-CONTINENT DISTRIBUTES THESE DELTA PRODUCTS:

Full line of Steel Tanks (Bolted and Welded), Heaters, Metering Equipment, Spherical, Vertical and Horizontal Separators, Emulsion Treaters, Low Temperature Extraction Units, Dehydration Equipment, Natural Gas Processing Units and other Petroleum Processing Equipment.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD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An automatic, self contained, skid mounted, rapid cycle adsorption process unit for extraction and recovery of hydrocarbon fractions from natural gas streams.
*Patented
DELTA SPHERICAL SEPARATOR
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Delta products for the oil field will now be distributed through Mid-Continent's world-wide sales and service facilities. Addition of this top-quality line is another example of Mid-Continent's continuing policy of providing the oil industry with *complete* in-the-field stocks and service. For detailed information about how you can profit from the long life and durability of Delta products, call your local Mid-Continent representative.

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Management Personals

F. O. Prior

J. E. Swearingen

▸ **Frank O. Prior** was elected chairman and chief executive officer and **John E. Swearingen,** president, of Standard Oil Company (Indiana) following retirement of **Robert E. Wilson,** chairman for 13 years. Prior has been president since 1955, Swearingen has been an executive vice president since 1956. In other moves, additional responsibilities, largely in the coordination of activities with some of the company's major subsidiaries, have been given to **Robert C. Gunness,** also an executive vice president since 1956, and **George V. Myers,** general manager of production, has been elected vice president for production.

Dr. Lawrence A. Kimpton and **F. Cushing Smith** were elected directors of Standard of Indiana. Dr. Kimpton is chancellor of the University of Chicago, and he replaces the late Judson F. Stone. Smith, general manager of the company's supply & transportation department, replaces Chairman Wilson.

▸ **P. C. Spencer,** president of Sinclair Oil Corporation, New York, was elected treasurer of the American Petroleum Institute. Spencer succeeded **B. B. Jennings** of Socony Mobil Oil Company, New York, who retired recently.

▸ **Edwin Singer** was elected chairman of the board of directors of Wilshire Oil Company and **Edwin G. Coopman** was made president and chief executive officer, succeeding **Robert O. Anderson.**

S. S. Kurtz Jr.

W. H. Barcus

▸ **Stewart S. Kurtz Jr.,** formerly head of the analytical division, was appointed research scientist of Sun Oil Company's research and development department. In a re-alignment of research service work, **W. Herman Barcus** becomes manager of a new research service division and **Robert W. Donahue** manager of the product development division which Barcus formerly headed.

▸ **L. F. McCollum,** president of Continental Oil Company, was elected a director of Chrysler Corporation.

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Screened Air Port

Unexcelled . . . for **Outdoor Use**

- DRIP PROOF
- VERMIN PROOF
- MOISTURE PROOF
- CORROSION RESISTANT
- FORCED AIR COOLED

All these features of Fieldmaster Ball Bearing Motors have been designed to overcome the rugged conditions of Oil Field requirements.

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CHECK THESE OUTSTANDING ADVANTAGES.

Heavy Cast base for alignment, stability, heavy duty, double-shielded, prelubricated bearings, reduces lubrication worries, high grade silicon steel in the magnetic circuit reduces iron losses . . . Wide variety of windings provides triple ratings, dual voltages . . . high torque licks heavy starting problems. High slip is available to take care of reciprocating load requirements encountered in pumping.

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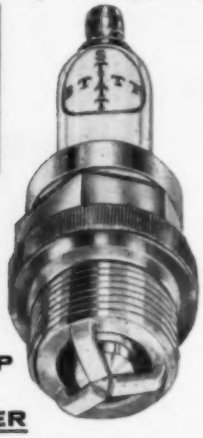
Manufactured by VALLEY ELECTRIC CORPORATION, St. Louis, 8, Mo.

STITT

new triple ignitors



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Gas engines provide the lowest cost, most reliable power for oil field use—and Field Reports PROVE that industrial engines are most efficient and economical when they are powered by STITT New Triple Ignitor spark plugs. STITTS hold gap setting longer, increase magneto life, cut "down time," give better performance longer in ALL your engines. To get long-life performance from your engines—regardless of make—send for FREE Pocket Catalog and Application Chart that specifies the RIGHT plug for ALL your engines.

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Dept. PE Columbus, Ohio

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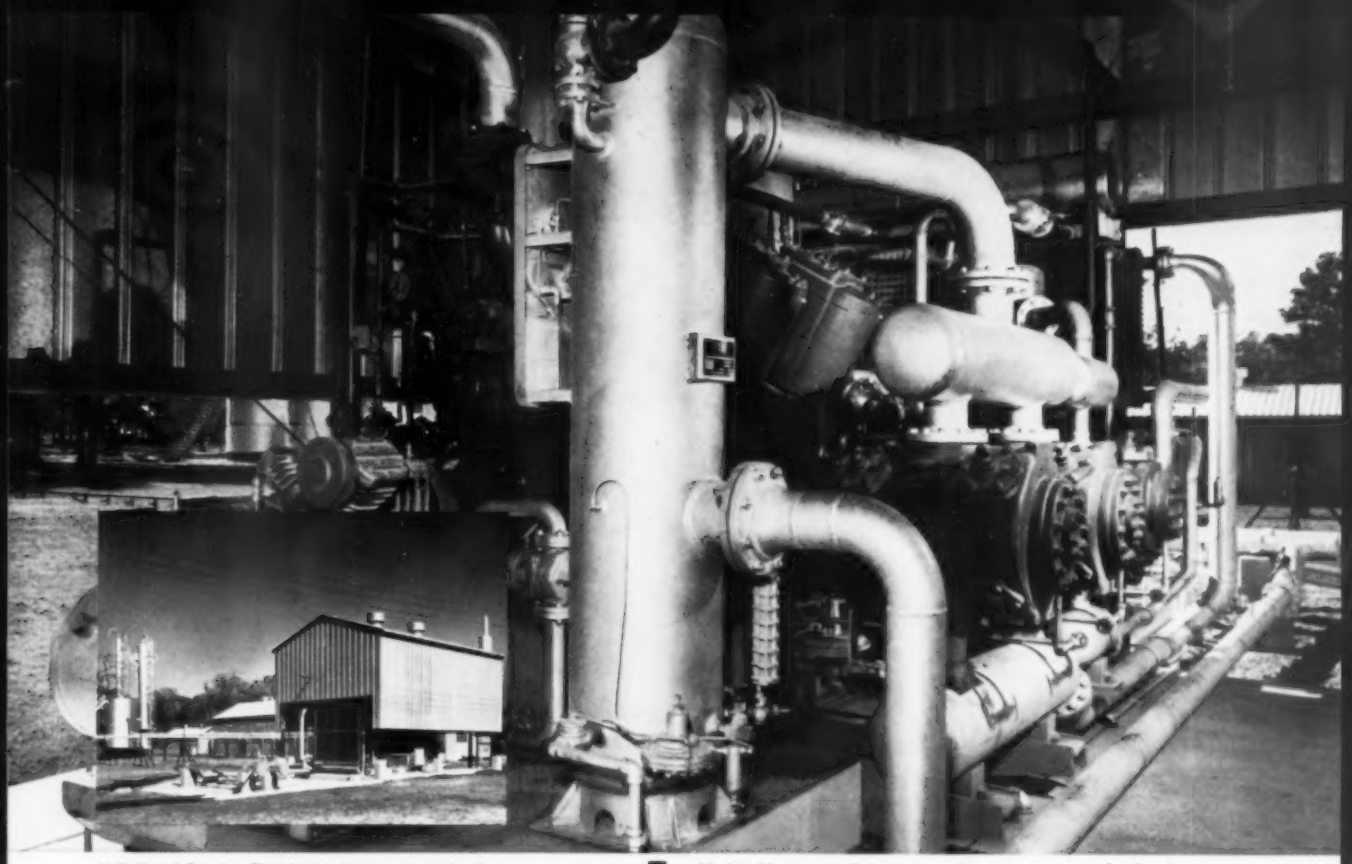
BEAIRD-INGERSOLL-RAND Packaged Compressor Plant



H. M. Harrell Recycling Plant booster station -- equipped with a Beaird - Ingersoll - Rand 6SVG 330 h.p. four cycle gas engine driven packaged compressor plant. Young radiator with lubrication oil cooler and gas coolers, and all necessary controls for unattended operation. Other sizes 120 to 660 h.p.

At Large Recycling Plant–

PACKAGED COMPRESSOR CONSERVES 2,000,000 CFD. IN LOW PRESSURE GAS

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another AMF product
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LOWEST COST PER HORSEPOWER INSTALLED

THE H. M. HARRELL RECYCLING PLANT serves a dual role. It repressures wells in the Bammel Field and injects gas into formation storage for a large Texas utility. Designed to operate with 400 psig. suction, the original plant was unable to pick up 2 mmcfd. in low pressure gas produced by five nearby wells. This gas has now been added to the plant through the installation of a Beaird-Ingersoll-Rand 6SVG 330 h.p. packaged compressor.

Picking up from the wells at 20 to 25 psig. the Beaird unit boosts the gas through two stages delivering it to the plant compressors at 450 psig. Critical input gas temperatures at plant compressors were met by equipping the packaged compressor radiator with gas interstage and after cooling sections.

The packaged compressor has been designed for unattended operation. Its driving engine is equipped with a regulator which enables the speed to vary from half to full throttle, controlled by the suction pressure. Discharge pressures remain constant. Other controls and shutdown devices protect unit from unforeseen operating conditions.

Let us show you how a Beaird-Ingersoll-Rand packaged compressor can be designed to meet your special requirements.

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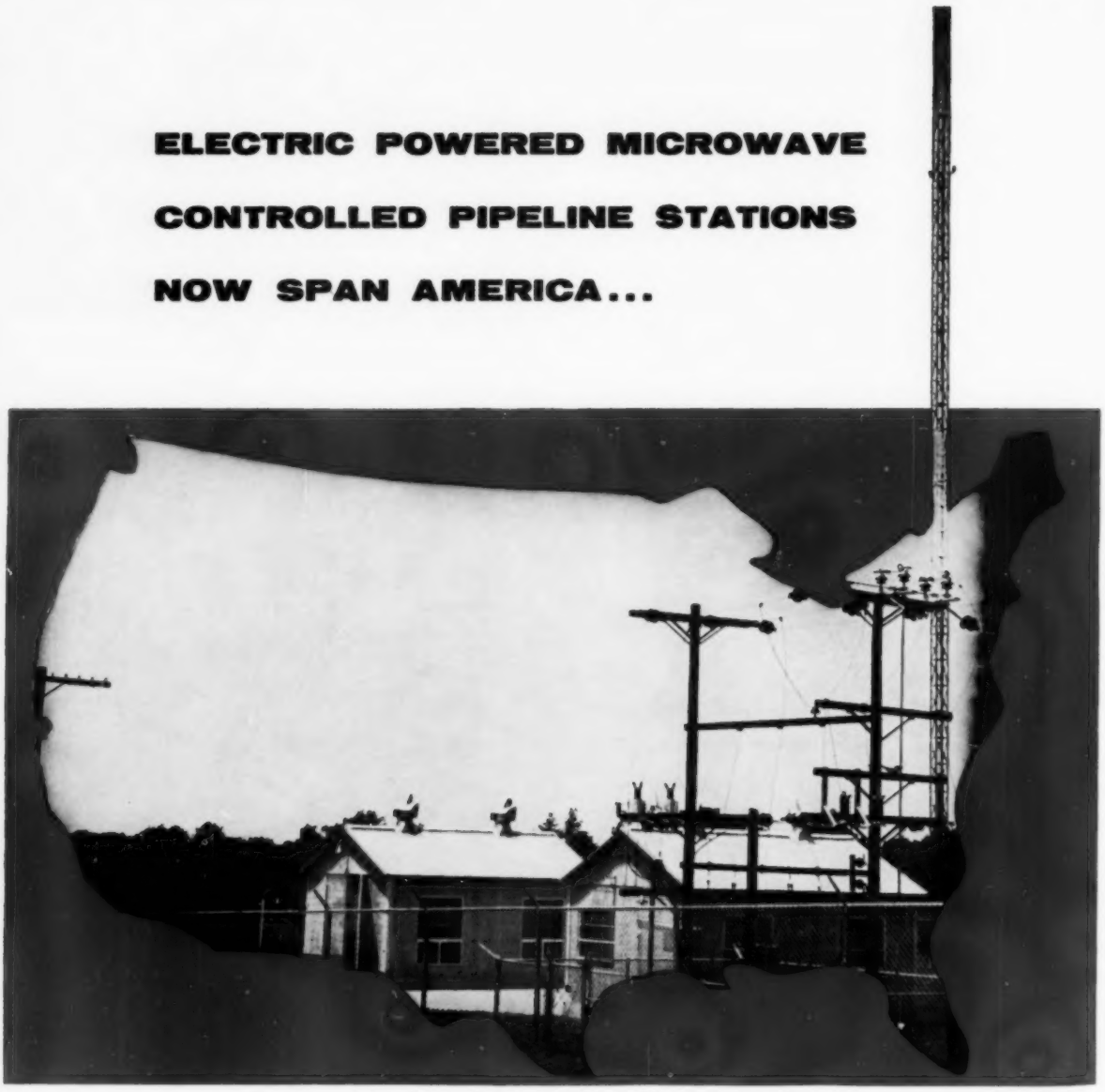

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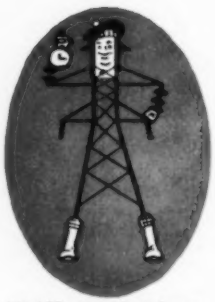
If you are in the pipe line transmission business . . . or if you contemplate having anything to do with pipe line transmission operations, don't sign any contract for power until you have carefully investigated the advantages of UTILITY ELECTRIC POWER. Of the 686,000 miles of pipe line systems in America, a big percentage of these is operated by Electric Power. When you have deliveries to make – at low cost – do it the modern, progressive way. Use UTILITY ELECTRIC POWER.



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A Guide to Books

Solvent Extraction in Analytical Chemistry, *by George H. Morrison and Henry Freiser, published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, New York. Pages, 269. Price, $6.75.*

Dealing primarily with extraction of metallic elements via formation of organo-metallic complexes, the text may find certain application in the petroleum industry. Particular emphasis is placed upon separation for determination of trace contents of primary metals as well as rare earths and precious metals.

A Survey of Secondary Recovery and Pressure Maintenance Operations in Texas in 1956, *published by the Interstate Oil Compact Commission. Pages, 178. Price, $2.*

A third in a similar series of surveys prepared by the engineering department of the Texas Railroad Commission has been published by the Interstate Oil Compact Commission. This survey contains data on 194 secondary recovery and pressure maintenance projects initiated between January 1, 1954, and September 1955, with data inclusive to January 1, 1956, and supplemental data on 436 projects previously reported in 1952 and 1954 surveys. Publication includes cross references to previously published surveys in regard to fields listed as well as a bibliography on secondary recovery with particular emphasis on reports of projects in Texas.

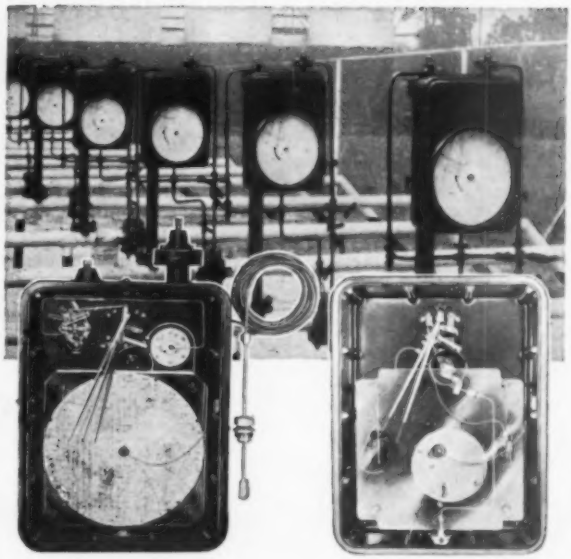
Oil and Petroleum Year Book, 1957, *compiled and published by Walter E. Skinner, 20 Copthall Avenue, London, E. C. 2. Pages, 765. Price, $6, post free.*

This is the 48th manual complied by Skinner, listing companies in the petroleum industry throughout the world. The book has a buyers guide section, contains tabulations of world oil production from 1947 to 1956, two color maps of Canada's oil and gas fields and transmission systems and of the Middle East oil fields. A section has been included listing management personnel, engineers and agents for companies listed in the volume. Company listings include information on the type of business, its directors and officers, business address, subsidiaries, capital and accounts.

Organic Syntheses, Volume 36, *published by John Wiley & Sons, 440 Fourth Avenue, New York 16, New York. Pages, 120. Price, $3.75.*

In this latest addition to the well-known annual series, 62 contributors supply tested methods for the preparation of 35 important reactions. N. J. Leonard of the department of chemistry and chemical engineering at the University of Illinois serves as editor-in-chief of the current volume.

More than 200 pipeline industry men attended the open house celebrating the opening of the new $60,000 office and warehouse of M. J. Crose Manufacturing Company, Inc. in Elizabeth, New Jersey. Among them were: W. L. "Bill" Glenn, Transcontinental Gas Transmission Corp., Linden, New Jersey; Mel Miller, Pipe Protection Service, Inc., Elizabeth; Bob Gates, Gates Brothers Marine Contractors, Little Ferry; Harry Burns, Hallen Construction Co., Island Park, Long Island. The Crose facility at Elizabeth will serve the eastern seaboard with the complete line of Crose pipeline construction equipment. The company's manufacturing facilities are centered in Tulsa, Oklahoma, and at Houston, Texas, where the firm's Cinch Division manufactures the Cinch pipe bending machine.



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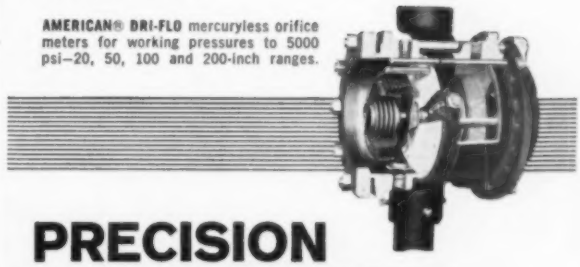

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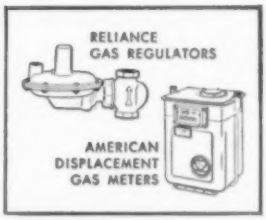
of flow, temperature, and pressure on one chart

Wherever precision measurement and economy of operation are required; at high or low flow rates, at varying temperatures, whether in recording, indicating, integrating or telemetering models, American orifice meters are synonymous with accurate, dependable, trouble-free service and low maintenance costs.



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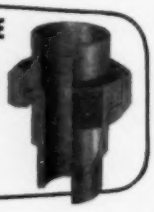

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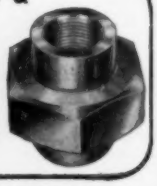

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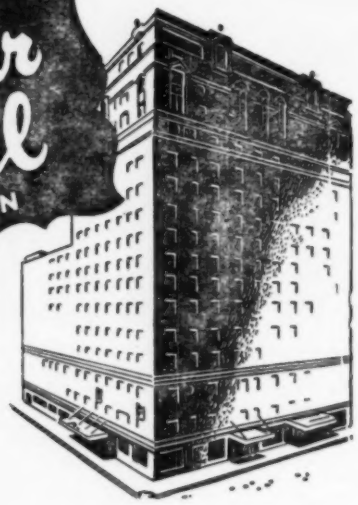

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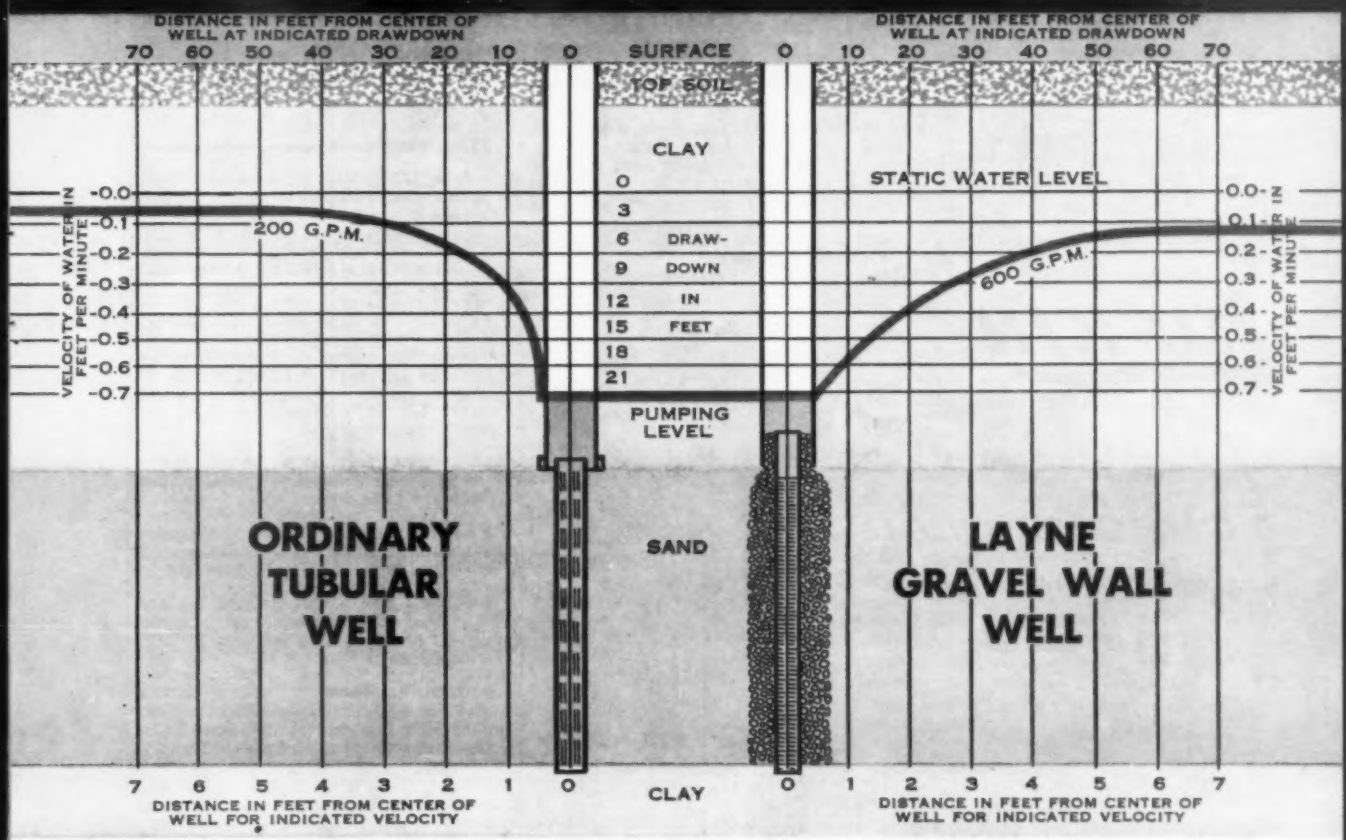

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Personals

Vern Taylor, manager, western region, producing department, Imperial Oil Ltd., was elected chairman of the board of governors of the Canadian Petroleum Association. He succeeds **R. C. Brown,** president, Hudson's Bay Oil & Gas Company Ltd. Re-elected to the board of governors, in addition to Taylor and Brown, were: **R. A. Cruickshank,** Canadian Devonian Petroleums Ltd., Regina; **Bart W. Gillespie,** Home Oil Company Ltd., Calgary; **C. E. Leach,** Tidewater Oil Company, Regina; **J. G. Spratt,** Triad Oil Company Ltd., Calgary; and **D. M. Tyerman,** McPherson, Leslie, and Tyerman, Regina.

Newly elected to the board of governors were: **E. C. Babson,** Union Oil Company of California, Calgary; **A. F. Beck,** Canadian Prospect Ltd., Calgary; **J. S. Black,** South Saskatchewan Pipe Line Company, Regina; **W. C. Howells,** McColl-Frontenac Oil Company, Ltd., Calgary; **Paul L. Kartzke,** Shell Oil Company of Canada Ltd., Calgary; **C. O. Nickle,** Conick Petroleums Ltd., Calgary, and **H. G. Schnert,** Sohio Petroleum Company, Regina.

H. G. Dunn was named assistant manager of the ad valorem tax department with headquarters in Dallas, Texas, Magnolia Petroleum Company. Dunn replaces **G. R. Alexander** who retires. Dunn was formerly tax agent since 1948, and from this position moves to assistant manager of the department.

Donlin P. Murdy was named vice president for finance and **Albert W. Gentry,** vice president for operations for Monterey Oil Company.

Joseph G. Davis recently joined The Superior Oil Company as assistant to the president.

Frank Pace Jr., former secretary of the Army and director of the Bureau of the Budget and now president of General Dynamics Corporation, has been elected a director of Continental Oil Company. He succeeds the late William V. Griffin who was chairman of the Brady Security and Realty Corporation, New York City.

Frank W. Piersol was appointed manager of Standard Oil Company of California's department on organization. Piersol succeeds **Lewis L. Purkey** who has retired. Piersol has served as head of the wage and salary division and later as assistant manager of the department. In his new post, he will direct organization and compensation planning for most of Standard's operations throughout the Western Hemisphere.

Kermit Roosevelt was named director of governmental relations, Gulf Oil Corporation. He plans to open offices in Washington, D. C., immediately. Roosevelt will maintain liaison between the company and governmental agencies of the United States and other countries in which Gulf does business.

Harry H. Siert, treasurer, was named vice president and treasurer of Northern Natural Gas Company. Other promotions include, **Frank H. Roberts** to chief accounting officer and **Ernest M. Petersen** to assistant to the president and assistant secretary.

Gen. Ernest O. Thompson, member of the Texas Railroad Commission, was appointed chairman of the legal committee of the Interstate Oil Compact Commission. Gen. Thompson has served as chairman of the legal committee for the past 8 years and was chairman of the IOCC for three terms — 1936-38.

W. B. Reynolds was named director of research for Phillips Petroleum Company. Reynolds, who was assistant director of research, succeeds **J. A. Reid,** new executive vice president and general manager of Astrodyne, Inc. **D. E. Carr** will be the assistant director of research and **F. E. Frey** and **T. W. Legatski** will be associate Directors of Research.

W. B. Reynolds

Morton A. Sterling was elected president of Sunset International Petroleum Corporation. He succeeds **J. D. Sterling,** who was elected to the recently-created position of chairman of the board. In 1950, Morton Sterling was named vice president in charge of production and elected to the board of directors. He has been executive vice president since 1955, and a member of the executive committee since 1956.

G. H. Hemmen was named manager, commercial development division, research department, Union Oil Company of California. In this capacity he assumes responsibility for the marketing of Union's technical developments. He has been chief engineer of Union's research department.

DEATHS

John G. Catlett, 72, prominent Tulsa oilman, died February 8 after suffering a heart attack.

C. L. Griffin, West Texas independent oil operator, died February 8 following a heart seizure.

A plane of R. L. Manning Company, drilling contractors, swiped a power transmission line near Bluff, Utah, during the week of February 3, killing **Milton M. Brown,** general drilling superintendent; **E. R. Hetard,** field superintendent and **Jimmy Johnston,** pilot.

Gordon L. Johnson, 63, retired cashier for Magnolia Petroleum Company, died February 11 of a heart attack.

Charles Cochran Harty, 47, accountant with General American Oil Company of Texas, died unexpectedly February 11.

Roswell Lee Clark, 65, of Abilene, Texas, an early wildcatter and independent oil operator, died February 20 after a long illness.

Orval F. Moore, 68, retired director and vice president of the Ohio Oil Company, died February 24 in Rankin, Texas. Stricken with a heart attack on February 11 while en route with Mrs. Moore from Findlay, Ohio, to California, he had been confined to the hospital since that time.

Alexander Hamilton Bell, pioneer California oil man, died February 24. Bell was a former Continental Oil Company executive who had been associated with D. H. Burden in the contract drilling business since 1947.

William M. Irish Jr., 89, former president and director of The Atlantic Refining Company died February 13 while vacationing in St. Petersburg, Florida.

Abraham Moscowitz, 62, chief chemist for L. Sonneborn Sons, Inc., Belleville, New Jersey, died February 11.

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There's no paint on Lufkin Chrome Clad "Atlas" Oil Gaging tape lines.

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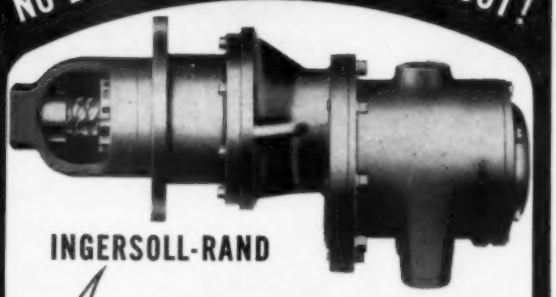

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Experienced in gasoline plant operations, former plant superintendent desires position with gas-producing or natural gasoline company. Experience also in gas contract work. Recent experience leaves me well-suited for contract department, operating department or in engineering department. Now living in Dallas, married, age 29. Would consider relocation. Box 196, Department C, The Petroleum Engineer.

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Need sales talent with good oil industry background? Young ambitious man desires position with equipment manufacturing or supply company selling to oil producing-pipeline-natural gasoline-refining industries. Specialized industry knowledge and excellent contacts that would be quite helpful to new or established firm. Dallas area location preferred, but not essential. Box 195, Department C, The Petroleum Engineer.

For Sale: 3 — LI-600 Cummins Engines diesel or natural gas. Ideco M-1000 Drawworks. Separate items or as a unit. Excellent condition, priced considerably below current market. Box 3266, Odessa, Texas. Phone FEderal 7-7622.

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that has stood all tests for over 45 years . . . on thousands of different applications . . . from tanks underground to aircraft in the sky.

For *permanently* leakproofing threaded connections, face joints, seams, valves, gaskets, pumps, tanks, oil burners, compressors, etc., and for coating surfaces against Gasoline, Propane, Butane, Carrene, Freons, Sulphur Dioxide, Methyl Chloride, Perchlorethylene, Coal Tar Chemicals, Transil Oils and other "Hard to Contain" Fluids, Gases, etc.

GASOILA is Easy to Apply - No Mixing Required
Never Hardens or Chips - Contains no Grit - Remains Elastic - Insures a Positive Joint but Easy to Take Apart - Flexible - Withstands Severe Vibration and Temperature Changes - Extraordinary Adhesion
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Control paraffin in tubing, flow lines and tanks by the CONSTANT injection of BRAKESOL. This eliminates costly Paraffin removal methods. Reclaim tank bottoms with BRAKESOL.

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Laugh with Barney

A man traveling in an upper berth was awakened in the night by a tapping on the bottom of his berth. He peered over the side and found the lady below trying to get his attention.

"I hate to disturb you," she said, "but I'm cold. I thought you might have an extra blanket."

"Are you married?" the man asked.

"Yes" was the shy reply.

"Well, in that case," he said, "let's get warm like married people do."

"What do you mean," she demanded.

"Get your own damned blanket!" he growled.

* * *

A man went to his neighbors to buy a rooster. The man of the house wasn't home, so the wife caught a rooster and gave it to the purchaser. "How much?" he asked. "$2," she replied. He handed her a $10 bill. "I can't change that" she said. "Pay me some other time."

Several days later the buyer met the woman's husband on the street. "Say, Joe," he hailed. "Here's the two bucks for the cock I got from your wife the other day."

The husband stared at him for a few seconds and said "that's OK — just keep it. I never give your wife anything."

* * *

An expectant father phoned the doctor to rush right over.

"Is she laboring?" asked the doctor.

"Hell no!" replied the man. "She's in bed yelling her head off and I'm doing all the work!"

* * *

Two honeymooning couples struck up a close acquaintance on the train and chose adjoining suites in the hotel upon arrival at Niagara Falls.

The very first evening they had supper together. After dining they decided they should all go to bed since they were all so tired from the trip. Just as they approached the elevators, the lights went off, throwing the entire hotel into darkness.

Groping their way up the stairs and to their rooms as best they could, they quietly undressed in the dark. George, who was a very devout man, knelt at the bed for his prayers. Just as he ended his prayers the lights came back on.

To his surprise, there in bed, in the sheerest of night gowns was June, the other man's wife, instead of his own bride, Ann.

In a panic, he started to rush to the other room. Then he heard June saying coyly, "It's too late to hurry now. My John never prays."

* * *

"One thing I learned in my long experience with the fair sex," said the sly looking one to his drinking companion, "is that you can't trust a woman with brown eyes."

"Yipps!" cried the other. "I've been married two years, but I don't know what color my wife's eyes are."

He dashed home. His wife was in bed. Creeping closer he lifted her eyelid.

"Brown, by God!" he roared.

Brown crawled out from under the bed and answered, "How in the devil did you know I was here?"

* * *

The Scotchman bought a car when he found out his wife had gas on her stomach.

New ...a powerful weed and grass killer prevents regrowth!

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You get Full Season's Control from One Application!

Only barren soil is safe from fire and other hazards! UREABOR destroys most all vegetation... for long periods. As little as 1 to 2 lbs. per 100 sq. ft. does this. Such low application rates mean savings on labor and storage space. UREABOR Weed Killer is always ready to use—DRY. Broadcast it by hand for spot treatments... use the handy new PCB Spreader for larger areas.

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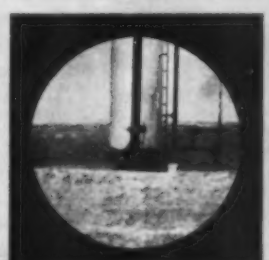
Use UREABOR to destroy vegetation about fence lines, well sites, pipe lines, refinery buildings, heater units, tank batteries, and all places where ground must be kept bare.

Write for literature today!



NOTHING TO MIX

NO WATER TO HAUL

NONPOISONOUS
When applied as directed

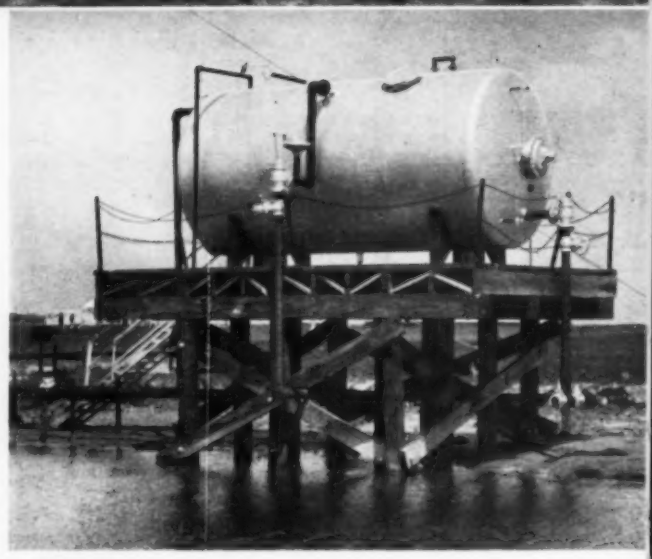
NONCORROSIVE
To ferrous metals

AGRICULTURAL SALES DEPARTMENT
United States Borax & Chemical Corporation
PACIFIC COAST BORAX COMPANY DIVISION
630 SHATTO PLACE • LOS ANGELES 5, CALIFORNIA

MANUFACTURERS OF FAMOUS "20 MULE TEAM" PACKAGE PRODUCTS

NATIONAL
PRECIPITATOR
and OIL REMOVER

The NATIONAL HORIZONTAL PRECIPITATOR AND OIL REMOVER is used where a large volume of water is to be handled and precipitants are present. Water is introduced through a flume downward into an enlarged section where velocity is greatly reduced, removing a great many solids. Any free oil rises to the top of the vessel. The water then travels through an excelsior section where minute suspended oil particles are coalesced. This oil rises to the skimming section and is drawn off. The water travels to a surge chamber from which it can be injected directly into the disposal well or filtered in a National Filter *if the condition of the water warrants it.* Skimming alone will not properly condition water for input. Coalescing is required for complete removal of minute oil particles, which is successfully accomplished in this unit. These units are available in a large range of capacities and sizes from over 50 Warehouses in the United States, Canada and Venezuela.



Write for Tank Topics
"Water Treating, Flood and Disposal"

It's a National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

TYPE "UA" ATTACHMENT

UNIVERSALLY ACCEPTED

THE UNIVERSAL TUBING HEAD ANOTHER O-C-T ACHIEVEMENT

This new and highly versatile tubing head permits an operator, regardless of well conditions, to complete wells singly or dually at will with complete control at all times.

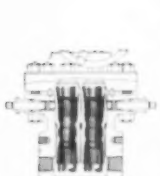
Whether you are drilling a well with a multiple completion in mind or not, the O-C-T Universal Tubing Head permits any last minute change in completion procedures without the necessity of changing tubing heads or using special attachments.

Check these outstanding features:

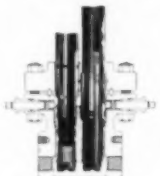
- Any API Head can be readily converted to a Universal by installing the UA attachment directly on top of the existing tubing head.
- Retractable aligning screws are used to align the dual hanger with respect to the head itself.
- These screws are placed in a retracted position when single string hangers are used.
- All hangers are run through, landed and locked in place prior to the removal of the blowout preventers.
- Once the head is installed, all seals can be field tested through test ports located in the flanges.
- The Universal Head is available in 600 through 2900 series and flange sizes from 6" to 10" for casing sizes 5½" through 7".

NO OTHER TUBING HEAD IS SO RUGGED, NOR SO VERSATILE

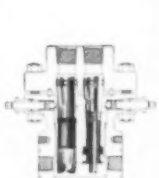
DUAL STRING HANGERS



TYPE U-60



TYPE U-70

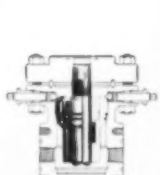


TYPE U-80

SINGLE STRING HANGERS

TYPE U-30

TYPE U-40



TYPE U-50

where progress is a daily practice

O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

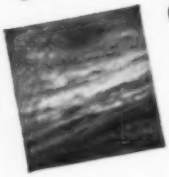
Export Representatives: South America — East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

IN

WATER FLOODING OPERATIONS

STOP PLUGGING

due to SCALE
CORROSION
TURBIDITY
MICRO-ORGANISMS



with

THE *Nalco* SYSTEM

■ You can keep water injection volume up, maintenance and replacement costs down with a Nalco program *designed to fit your specific operating conditions.*

Your Nalco Field Service Representative is skilled in water treatment—and is backed by the world's largest water treatment organization. His recommendations for your treating program, and continuing responsibility, will be aimed at keeping your water *and oil* conditioned for best operating results at the lowest possible cost. Call him today, or call us direct, for prompt action.

NATIONAL ALUMINATE CORPORATION
Telephone Portsmouth 7-7240!
6212 W. 66th Place • Chicago 38, Illinois
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THE *Nalco*®
SYSTEM • Serving the Petroleum Industry through Practical Applied Science

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Of Things To Come . . . In Oil

SOLUTION TO INDUSTRY'S ECONOMIC PROBLEMS, says John B. Hussey, Conservation Commissioner for Louisiana, is five-fold: (1) Restrict crude and product imports; (2) set wider well spacing; (3) improve oil recovery methods; (4) restrict condensate production, and (5) permit natural gas to seek its proper economic level as a fuel and energy source. Comm. Hussey gave these points before API's Southern District meet in Houston February 27.

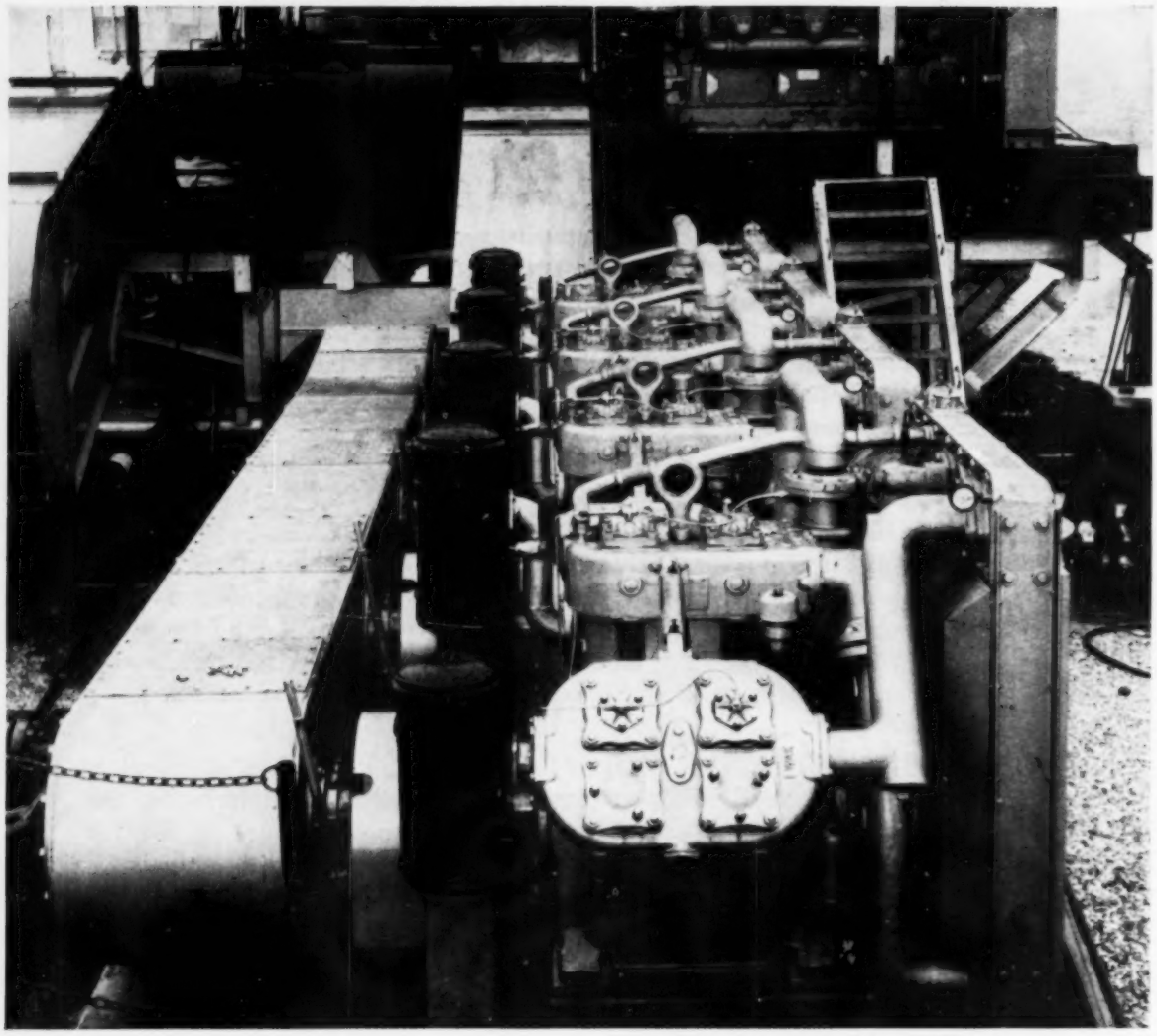
GOVERNMENT SEEKS MORE POSITIVE CONTROL ON ALL IMPORTS, according to indications given in recent congressional hearings on reciprocal trade agreement act. Lack of U. S. control over products, plus the deluge of new import quota requests have left government officials muddled as to how to handle the situation on a voluntary basis. And, many independents are clamoring for strict federal control of petroleum imports.

WORLD-WIDE OFFSHORE DRILLING HAS JUST BEGUN . . . predicts James Terry Duce, vice president of Aramco in a talk before the AIME in New York. There is also as much area perspective for oil offshore as on the continents. But, the problems of oil at sea will occupy lawyers and statesmen for years in solving boundaries and legal aspects.

NEW MUD TO SOLVE HEAVING SHALE PROBLEM . . . one of drilling's age-old headaches . . . especially in the Gulf Coast. A new idea in drilling fluids, uncovered by Texaco research at Bellaire, Texas, makes it possible to "stabilize" the hole so that shales are solidified. They call it TSCM . . . or Texaco's shale control mud.

DON'T LOOK FOR FAVORABLE LEGISLATION THIS YEAR in petroleum. Magnified and distorted newspaper stories of the industry's internal problems, over-amplified involvement in politics, mounting import problems, deluded picture by public of oil as characteristically wealthy; clamor for more federal control . . . all add up to a cloudy and problem year.

USE OF ALUMINUM TO INCREASE 500 PERCENT IN NEXT THREE YEARS, predicts W. B. Moore, Reynolds Metals Company, before Southern District API Meeting in Houston. Drilling and production used 10 million lb in 1957 . . . should increase to 65 million lb by 1960 in offshore structures, pipelines and oil country pipe.



An assembly of four Gardner-Denver WBK-C4 compressor units.

Engineered for your air drilling needs

Is your air drilling project in the planning stage? Here's a compressor package designed especially for it—the Gardner-Denver WB air drilling unit. Each packaged unit consists of water-cooled compressor, intercooler and aftercooler, engineered to deliver cooler air at the header. The WB is built for continuous service and is easily maintained at the drilling site.

Gardner-Denver has the facts

Get in touch with your Gardner-Denver compressor specialist. His knowledge of circulation problems is backed by three generations of Gardner-Denver service to the drilling industry. He can help plan the correct installation for any air drilling or mud aeration application. Gardner-Denver compressor specialists are located throughout the oil fields.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

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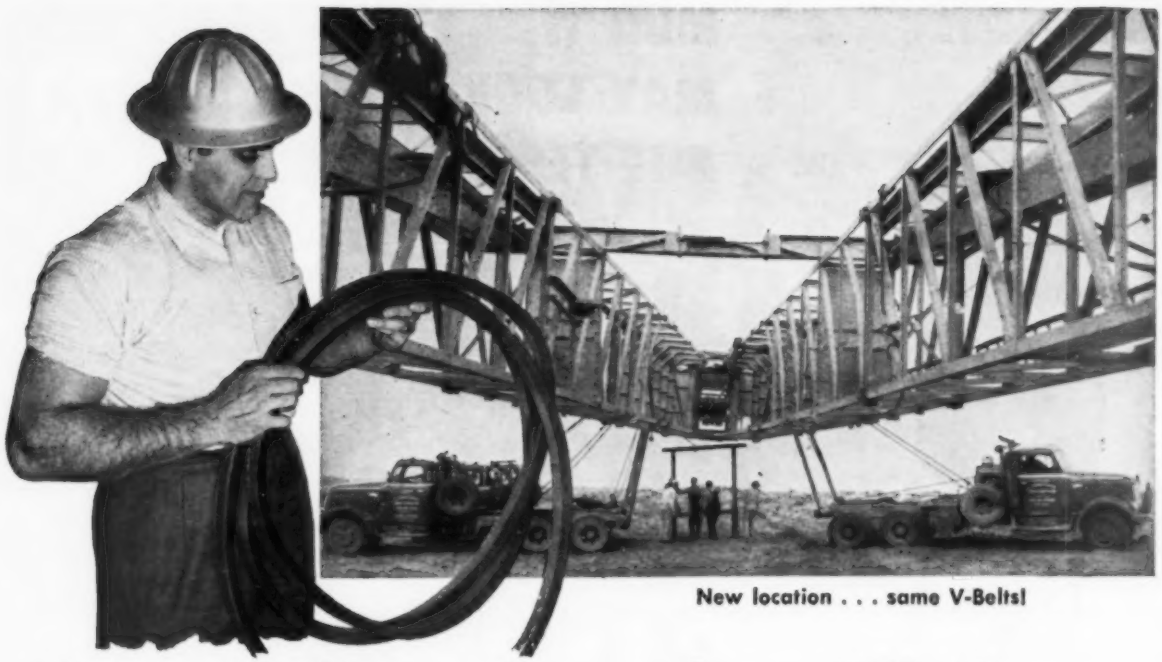
Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario
Gardner-Denver Export Division, 233 Broadway, New York, N. Y.
Oil Field Offices: Dallas, Houston, Tulsa, St. Louis, Los Angeles, New York, Pittsburgh, Denver, New Orleans, San Francisco, Kansas City, Winnipeg, Edmonton

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD



New location . . . same V-Belts!

More drillers depend on Rib-Tops than any other V-Belt in the world

Gates Rib-Tops are the only V-belts designed specifically for mud pumps. Superior design and construction mean longer life . . . less down-time . . . much lower belt replacement expense. Yet Rib-Tops cost no more than ordinary belts of comparable ratings.

Both Standard and Super Rib-Top are available at your oil field supply house.

For Toughest Drives Use *Super* Rib-Top

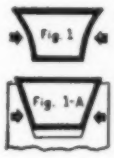
With 40% greater horsepower capacity, Super Rib-Top easily handles overloads. Fewer belts and narrower sheaves solve space and weight problems.

The Gates Rubber Co., Denver, Colo.

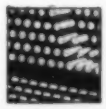
No other V-Belt has ALL these advantages

1. Stabilizing ribbed tops (U.S. Pat. 2548135) are exclusive with Gates. They dampen vibration, protect top of belt from damage, keep belt running smoothly over idler-equipped mud pump drives with no side whip.

2. Flex-Weave Cover (U.S. Pat. 2519590) A Gates exclusive: provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . . more power available to driven machine.



3. Concave sidewalls (U.S. Pat. 1813698) Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . far longer belt life.



4. Tougher, more resilient cords are able to absorb the severe pulsations of mud pumps; easily handle peak loads.

TPA 300

Gates *The Mark of Specialized Research*

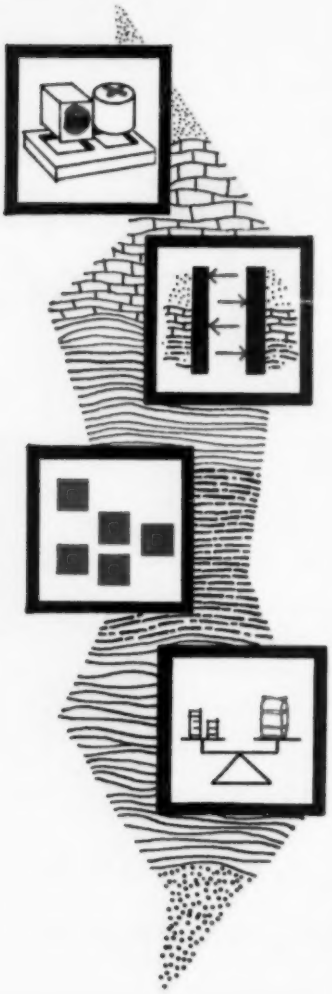
Gates Rib-Top Vulco Rope

DEVELOPED ESPECIALLY FOR MUD PUMP DRIVES

Seeing Is Believing . . .

MUD WEIGHTING MATERIALS MAY LOOK ALIKE . . . BUT TESTS SHOW

BAROID* PERFORMS BETTER



All barium sulfate mud weighting materials look and weigh about the same, but they perform differently. Each mud company sets its own standards of quality. BAROID meets the highest standards.

These differences in standards can mean added expense to control the three basic properties of drilling mud: weight, filtration and flow properties.

One brand of weighting material may give your mud twice or three times as much gel strength, viscosity or filtrate loss as another brand. WHY TAKE CHANCES?

Seeing is Believing . . . Use BAROID, *the winner in performance!*

BAROID

BAROID DIVISION • NATIONAL LEAD CO.

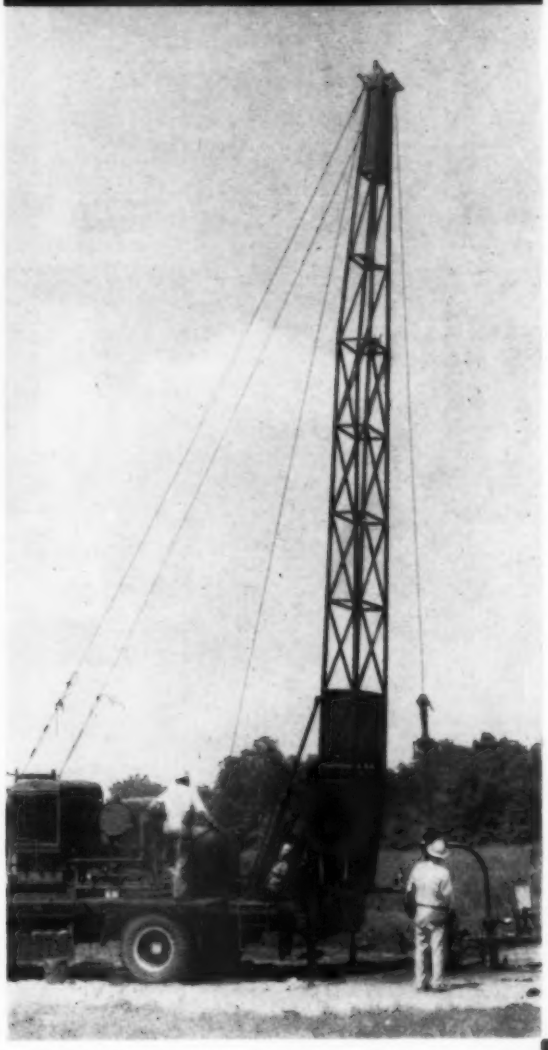
Main Office: P. O. Box 1675, Houston 1, Texas

*Registered Trademark, Baroid Division National Lead Company

B 6812

CONTROLLED SWABBING

with Guiberson Swabs



When you're ready to unload or swab test your well, Guiberson fast-falling swabs will do your job at the lowest possible cost.

You get better control of swabbing costs through selection of proper cup size and type. You can match the cup to the situation . . deep or shallow wells . . light, medium or heavy loads . . smooth, rough or tight tubing.

You get maximum control of results, too, when you use the right cup for your particular job. Maybe that calls for lifting lots of fluid fast . . or lighter loads at slower speeds to protect a permeable sand face. One of the several types of Guiberson cups in a wide range of sizes will suit the circumstances and you can put the well on production quickly.

Lift more fluid in fewer trips with Guiberson's fast-falling, smooth-pulling swabs.

Cups are compounded to Guiberson's exclusive formulas for maximum balanced resistance to oil . . acid . . abrasion.

THE GUIBERSON CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

Sold by
Oil Field Supply Stores
Everywhere

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

You are jetting away money uselessly — if you aren't using the HOMCO Closed Circuit Dual Centrifuge. 16 pound mud costs from ten to twenty dollars per barrel. Are you jetting these barrels of dollars away? The HOMCO Closed Circuit Dual Centrifuge reclaims the barite, the emulsion, the chemicals, the water and DISCARDS ONLY THE DRILLED SOLIDS.

HOMCO
HOUSTON OIL FIELD MATERIAL COMPANY Inc.
HOUSTON, TEXAS

THE WORLD'S LARGEST INDEPENDENT OILFIELD SUPPLY AND SERVICE ORGANIZATION

RESEARCH • ENGINEERING
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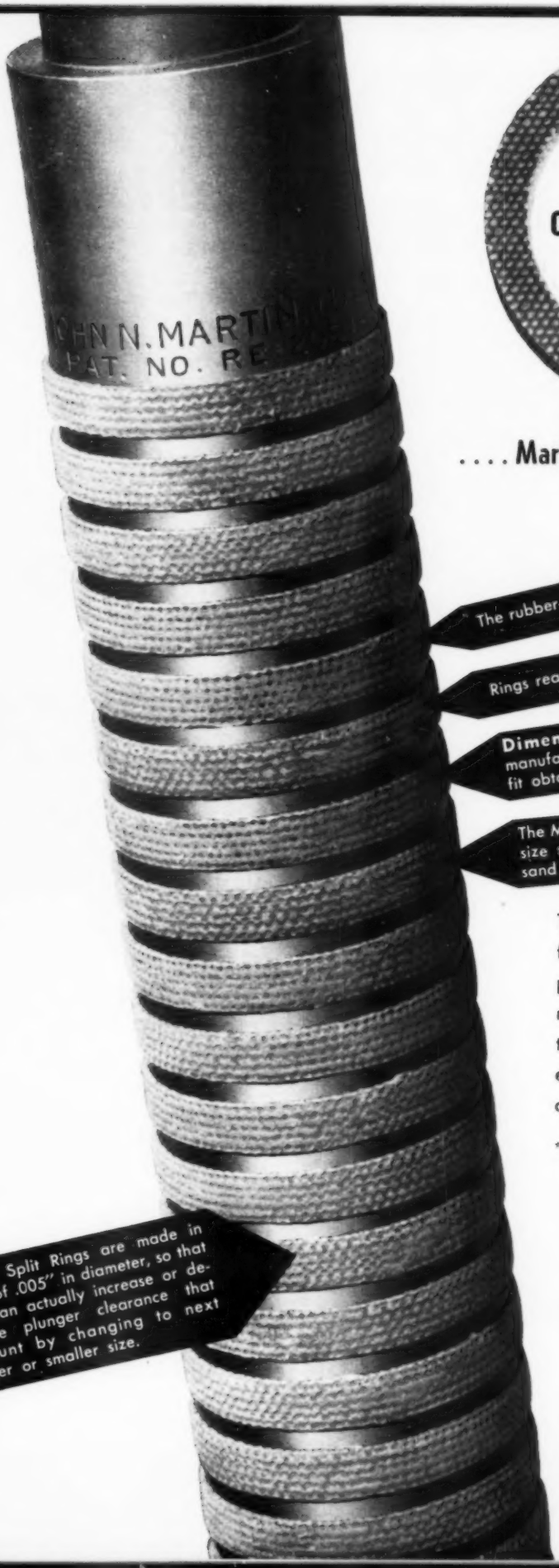
DIRECTIONAL DRILLING • FISHING & CUTTING • ELECTRICAL WELL SERVICES • OILFIELD SUPPLIES • EXPORT TOOLS & SERVICE



GETTING CORRECT RING FIT IS EASY WITH

.... Martin Plungers and the Martin Method of Installation*

The rubber-and-duck rings swell **just so much** and no more.

Rings reach maximum size in the well within a few hours.

Dimensional Compensation during the manufacturing process assures the uniform working fit obtained with Martin Split Rings.

The Martin Ring Size Guide Table* assures proper ring size selection for various gravities, temperatures and sand and water content.

Martin Split Rings are made in steps of .005" in diameter, so that you can actually increase or decrease plunger clearance that amount by changing to next larger or smaller size.

The gaps between the Martin Rings cause fluid turbulence which slows down slippage past the Martin Plunger — just as a rough road slows down your driving speed. Actually, the Martin Plunger maintains pumping efficiency with a looser fit than is possible with a smooth surface plunger.

* See the complete Martin Catalog and instructions in the 1957 Composite Catalog.

JOHN N. MARTIN
Manufacturer
9 W. BRADY • TULSA, OKLA.

There's RESERVE CAPACITY in this LIGHTWEIGHT PUMP

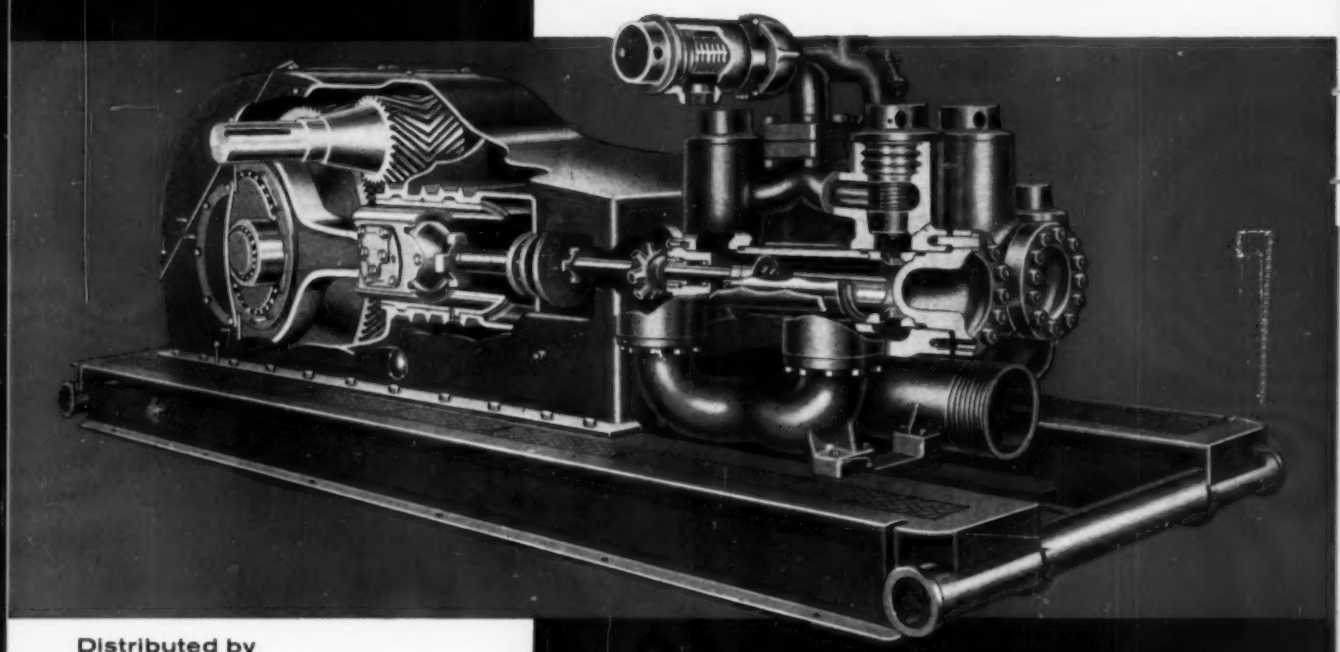
Examine this cross section of a Continental-Emsco Series D Slush Pump. Note how *extra power* has been built into the large main gear . . a wide-faced, forged-steel herringbone gear . . heat treated for years of heavy-duty pumping. The pinion and pinion shaft are integral . . made of high-alloy, forged steel . . fully heat treated.

Eccentrics are equipped with large diameter roller bearings, which results in an extremely narrow and compact power end. The eccentric straps are made of one-piece alloy steel.

You can see how the sides of the power-end housing are not thick, as are solid castings. Steel plates and shapes have been utilized instead of bulky castings to provide a light, rigid power-end. This is *Fabriform construction* . . the big *weight-saving* feature of Continental-Emsco Pumps for lower-cost transportation and easier rigging-up. You get *more horsepower per pound* than in any other slush pump.

Maintenance features are outstanding in the design of the D Series Slush Pumps. Patented "exposed" liner design *minimizes fluid-end washouts* caused by liner-packing failures, and no greasing is necessary, since lubrication is completely automatic.

One of these six Continental-Emsco Slush Pumps will meet your drilling requirements: D-175, D-300, DA-500, D-700, DA-850, D-1000. Ask your supply representative for all the data on these pumps.



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Serving the Oil and Gas Industries ... Worldwide

SP708

CONTINENTAL-EMSCO COMPANY • A Division of The Youngstown Sheet and Tube Company
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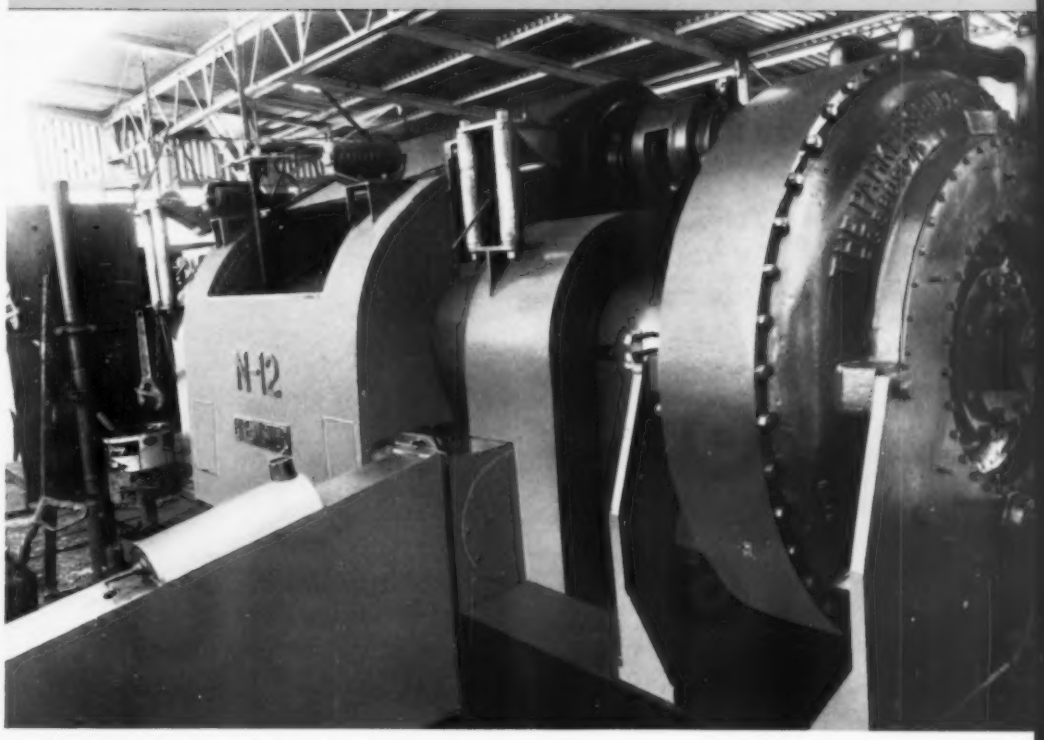
BIG, TOUGH AND PROFITABLE



Big drum and big brakes save money and maintenance costs.

BREWSTER N-12 DRAWWORKS

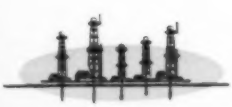
Ability to take the toughest going and still complete the hole on time has helped make the rugged Brewster N-12 number one choice of deep hole contractors like Zack Brooks. His N-12 gives him the added advantage of long trouble-free service, economical performance and utmost dependability. Here are a few of the features that will give you a profitable competitive difference when you run a Brewster N-12 on your deep work.

DESIGNED FOR 10,000 TO 20,000 FOOT DRILLING — Heavily shafted and chained the drawworks will take full rig horsepower at the drum.

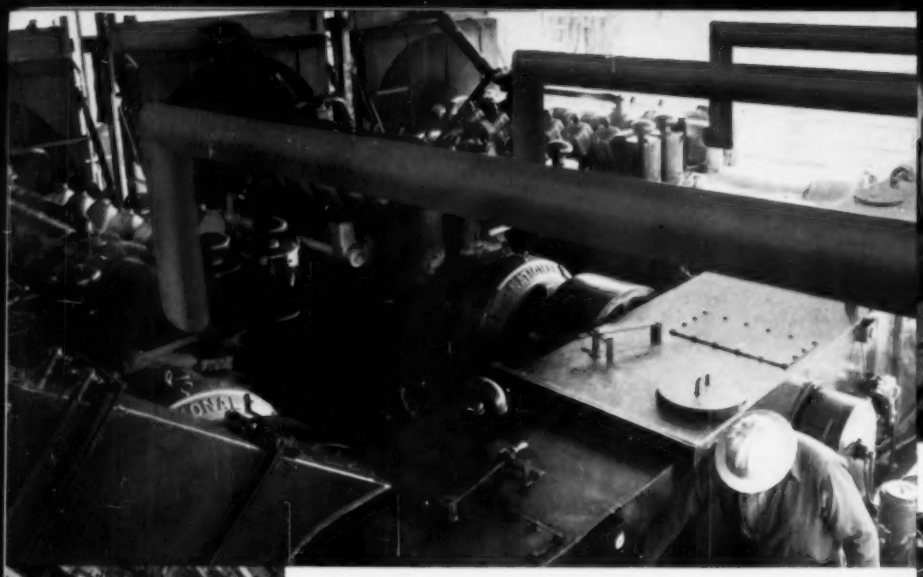
GRADUATED POWER TRANSMISSION — Four transmission speeds are combined with high and low drives at the drum to give the driller eight hoisting speeds and a reverse. Each speed is graduated to provide a 38% increase.

HEAVY DUTY COMPOUNDS — Box type or sectional for low or high speed engines.

Put yourself in a competitive position on deep hole contracts — check with Brewster on the profitable competitive difference built into Brewster Big Rigs.



CONTINENTAL-EMSCO COMPANY



Brewster oil bath rotary tables are unequaled for long reliable service.

A rugged compound on the N-12 gives reliable power under heaviest loads.

For fast round trips, for time-saving drilling in any formation, get Brewster Matched Drilling Equipment. It's matched to the speed and power of the drawworks. Here's a well-balanced team to cut your drilling costs — and to bring new speed and profits to your work. The Brewster N-12 drawworks—Model 500 traveling block, the RSH 27½ oilbath rotary and the 8-SX oilbath swivel.

THE BREWSTER COMPANY, INC.
Shreveport, Louisiana

Simplified air controls add speed and safety to rig operation.

SUPPLY HOUSES

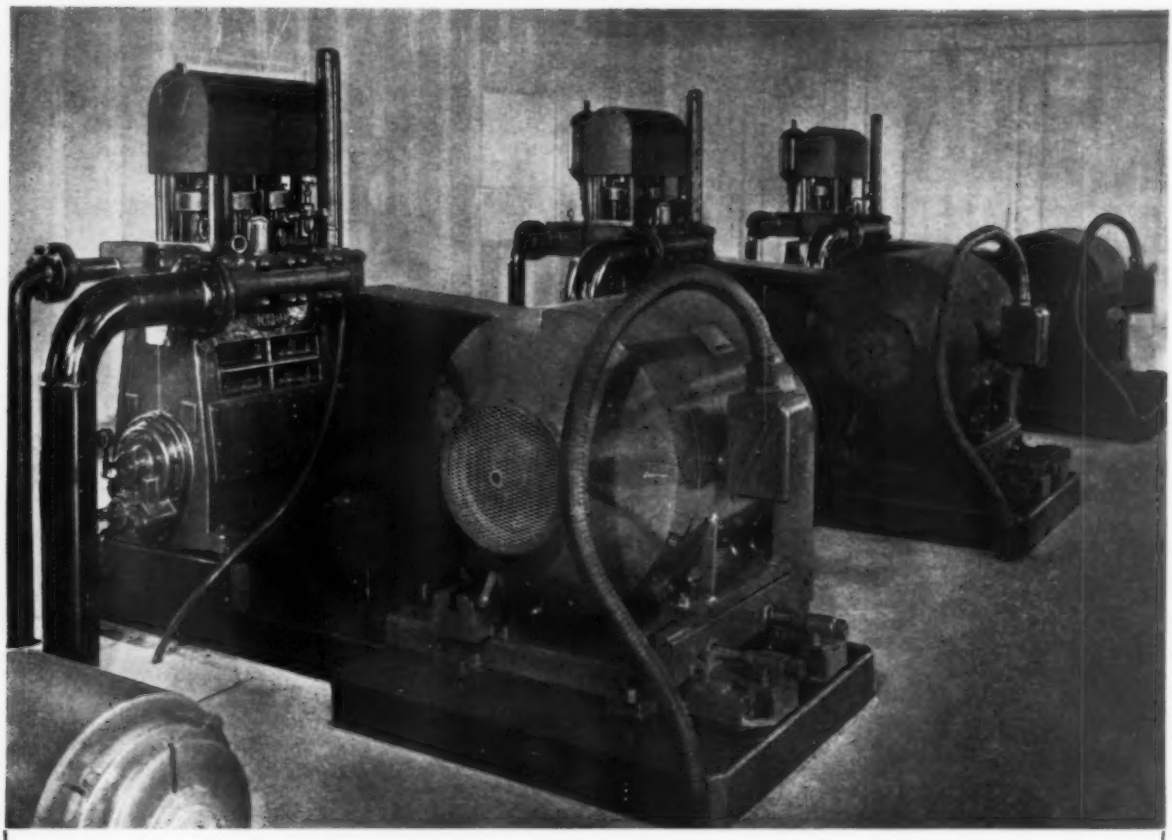
Howard Supply Company
Apex Equipment Company
Bovaird Supply Company
Industrial Supply Company
Murray Brooks, Inc.
United Supply and Manufacturing Company
Export Sales:
The Brewster Company
(HOMCO) Houston Oil Field Material Company, New York, N. Y., Houston, Texas; Mexico City, D. F.

The traveling string has added dependability when it is Brewster matched equipment.

SPECIFICATIONS

Recommended Available H. P.	1500
Drum Brakes Width x Diameter	10" x 54"
Drum Core Diameter x Length	30" x 54"
Minimum Sprocket Size in Transmission	28 Tooth
Transmission Forward Speeds	4
Transmission Reverse Speeds	1
Skid	3 Beams 14 x 12 H — 7' 9½" wide
Overall Height	7' 10½"
Overall Width	9' 5'
Overall Length	22' 10"
Approximate Weight (less Hydromatic)	55,000#

In-line pump drives save time and cost in pump manifolding.



FIELD REPORT

FLOOD: Loudon-System No. 2

PUMPS: 24 Aldrich Direct Flow Triplex

PUMPS INSTALLED: April 1953

EXPERIENCE TO DATE:

Carter Oil Company reports..."Pumps are in continuous operation. Very satisfactory service — very low operating cost...equal to, or less than, any other type pump used similarly. Excellent service from area representatives."

Field parts stock available in Carmi, Ill., Charleston, W. Va., Houston, Los Angeles, Odessa and Tulsa. For further information, write the Aldrich Pump Company, 26 Pine Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

Allis-Chalmers dozers

Here a 94-belt hp, 24,800-lb. HD-11 dozes out a slush pit. By pulling one lever, operator can shift from any of the six forward speeds to any of the three reverses. By using the high-speed reverse, he can back up in a hurry—convert maneuvering time to production time.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

hog dirt out quick on oil field jobs

Ramming out slush pits, leveling drill sites, carving access roads, building fire walls—whatever the job, you get high production with an Allis-Chalmers crawler tractor-dozer package.

Here is why. Because each dozer is designed specifically for the tractor it mounts on, you get a unit that is exactly the right size with maximum strength without excess weight. Dozer is mounted in the right location to provide a balanced tractor-dozer package with high dirt-moving ability under any terrain or job condition.

Proper blade curvature keeps dirt "live" and rolling for bigger loads with less tractive effort. Specialized grading and sloping jobs are handled accurately with easy-operating pitch and tilt adjustments.

Allis-Chalmers dozers are tough

These long-life dozers are the product of the latest design and manufacturing techniques. Automatic electric welding, line boring of brackets, and proper reinforcing assure lasting alignment. All possible points of wear—trunnions, pin connections, ball and socket joints—are hardened to keep the dozer "tight" even after long hours of hard work.

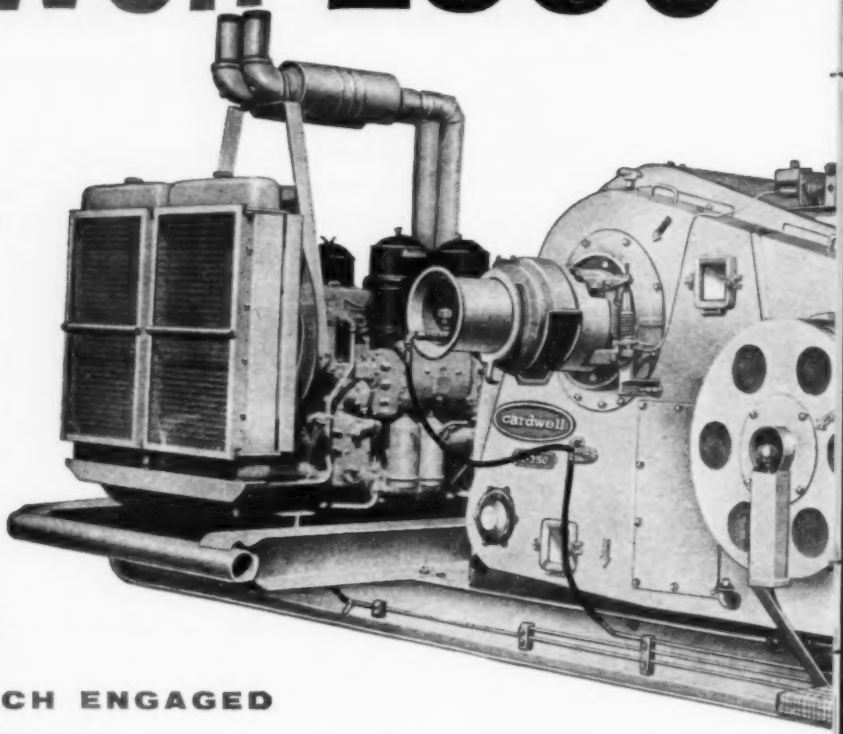
Matched to a great crawler line

Allis-Chalmers crawlers are designed to give you big-money dirt-moving performance. Powerful Allis-Chalmers engine, all-steel Box-A Main Frame, unit component construction, new ceramic-lined master clutch, new extra-tough track are just a few of the reasons why. Your nearby Allis-Chalmers dealer can point out many more.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

Cardwell L350



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- **DOUBLE END DRUM DRIVE**
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- **FRICTION CLUTCH ENGAGED HYDROMATIC BRAKE**

Cardwell L350 rigs, in operation throughout the world – including Canada, Venezuela, and Austria, have proved their versatility. The L350 is equally adaptable to sub-structure mast or trailer mounting, and may be used either with Cardwell trailers and masts or other makes now available.

With a wide range of adaptable engines, it can be tailored to meet all your requirements – for shallow- and medium-depth wells, or for deep workover and slim hole drilling. Hydromatic brake and sand line drums are optional, and can be added at any time.

Driller's console is well-forward, and gives a full view of all drilling operations. Single-lever air controls operate drum clutches and throttles, increase safety and efficiency.

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★ **Externally Mounted Friction Clutches** – of latest modern design. Fawick VC (ventilated construction) – are outside mounted on ends of shaft for easy accessibility.

★ **Oil Bath Lubrication** for all chain drives assures long life and low maintenance.

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THIS MODERN PACKAGE can be mounted on sub-structure or skid-base portable masts, platforms, or conventional derricks. With two engines, unit is 272⅝" long by 116½" wide *(less catheads)*, and stands 93" high. With one engine, overall length is 253".

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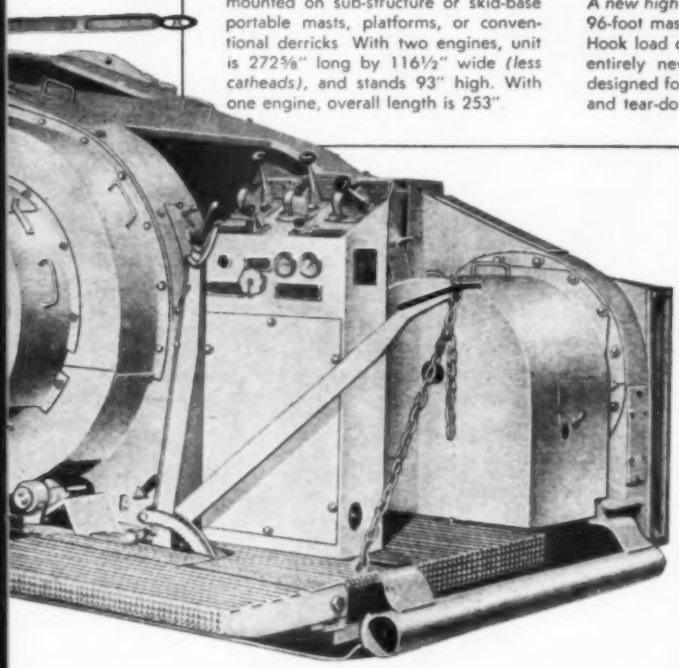
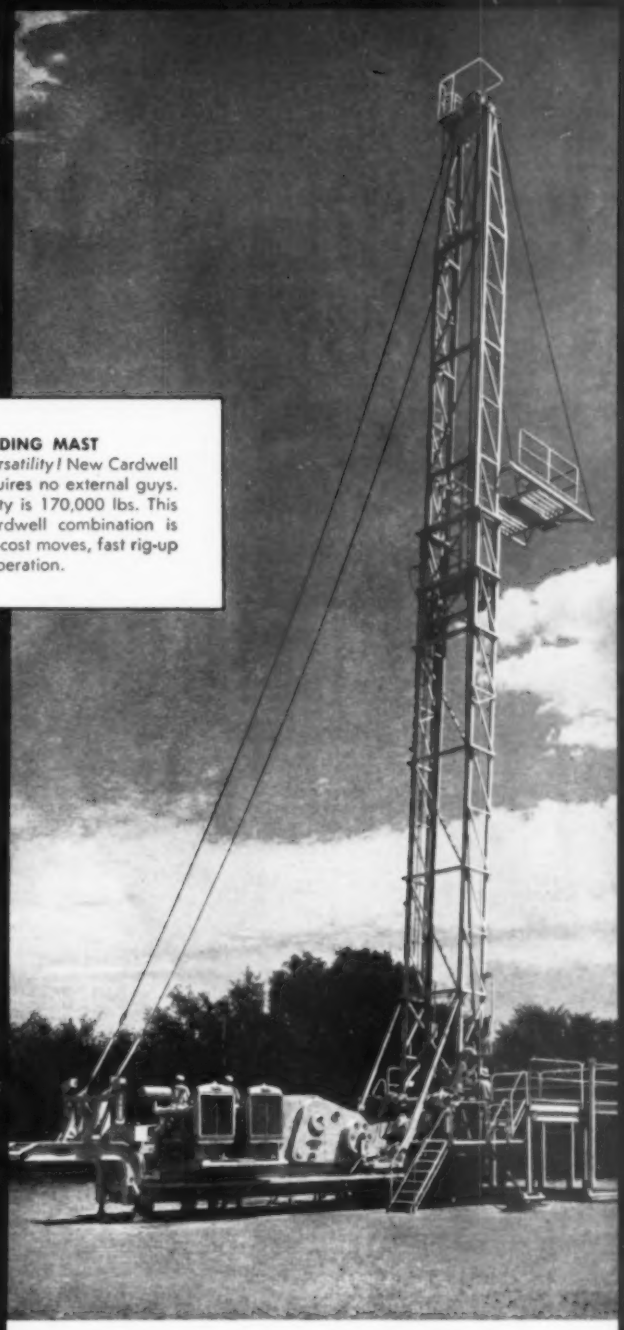
A new high in versatility! New Cardwell 96-foot mast requires no external guys. Hook load capacity is 170,000 lbs. This entirely new Cardwell combination is designed for low-cost moves, fast rig-up and tear-down operation.





★ **Hydromatic Brake** with friction clutch is optional. Integrally mounted 15" double rotor brake with friction-engaging clutch provides fast, smooth operation. This combination speeds operation, saves trip time, and reduces wear.

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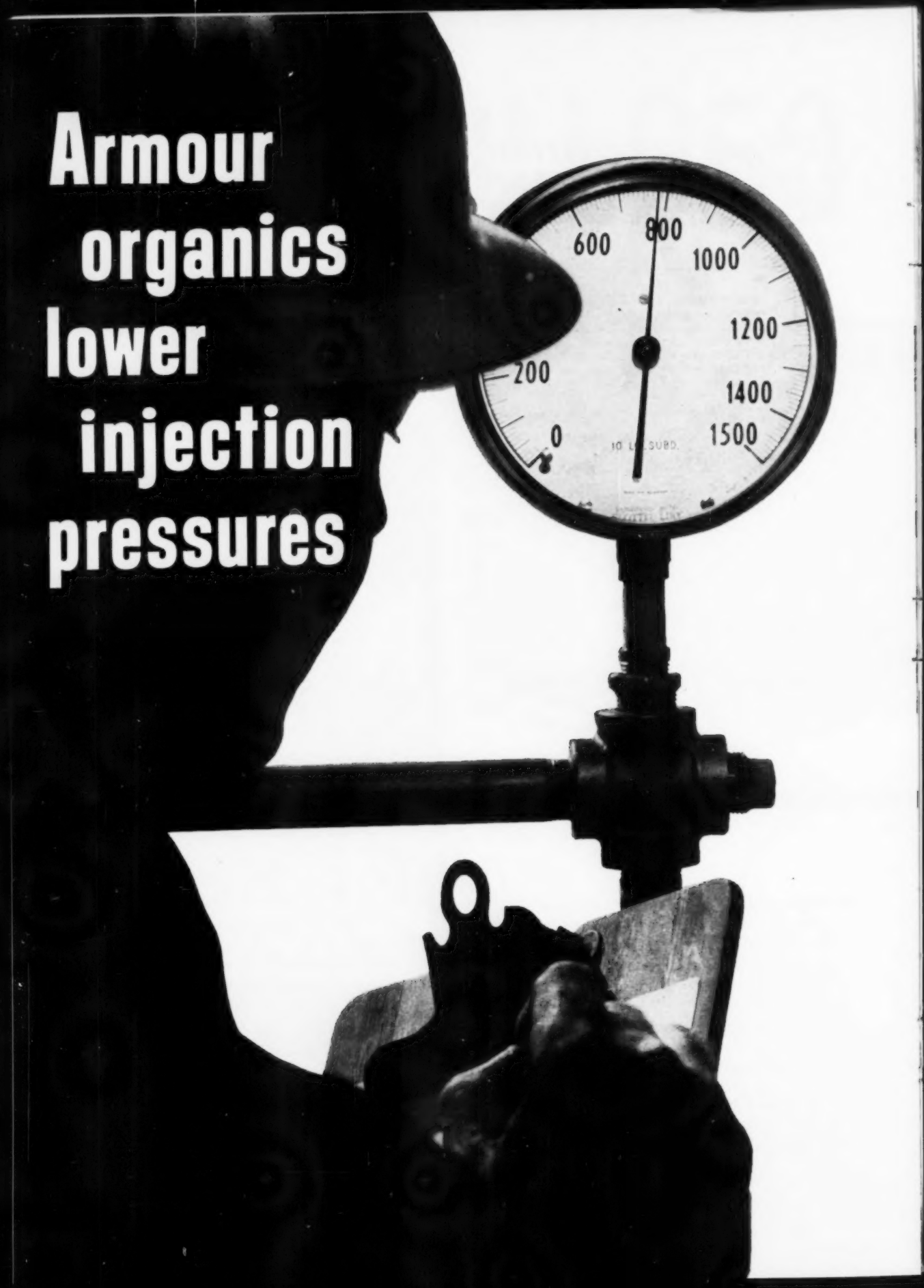
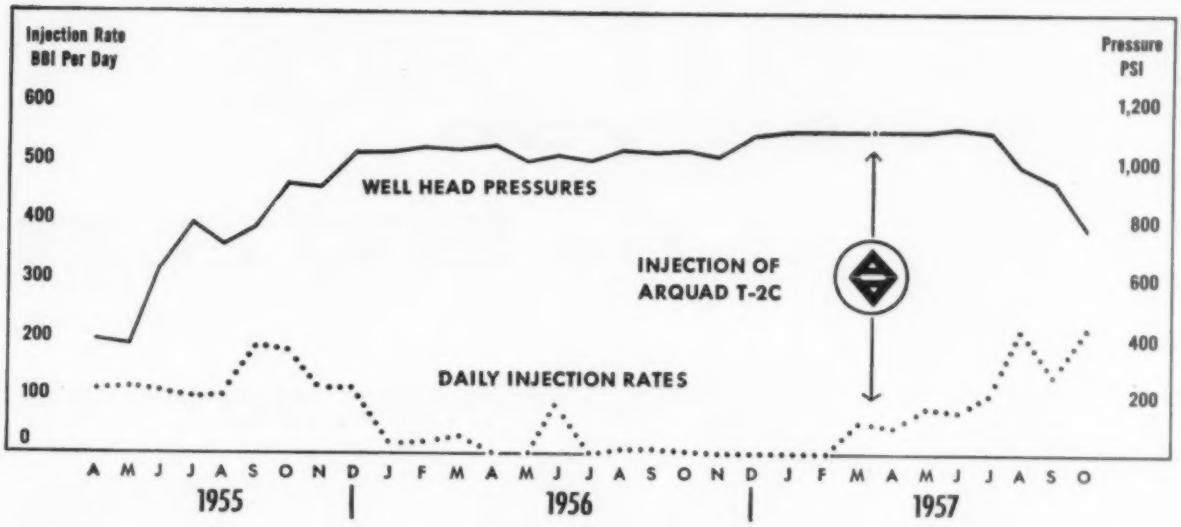
Armour organics lower injection pressures





Well head injection pressure down from 1100 to 780 pounds, injection rate up from 30 to 220 bbls. per day at eastern Oklahoma water flood. This performance chart offers recent, conclusive proof how an Armour organic, Arquad® T-2C, makes possible more efficient oil recovery.

Armour organics stop corrosion—control bacteria. And by lowering surface tension of water they increase injection rates and decrease pressures for more efficient oil recovery!

Armour water-flood chemicals Armac® CD-50, Arquad® 12-50 and Arquad® T-2C are being used to lower injection pressures. These polar organic surfactants produce a detergent effect in water that apparently "scrubs" more residual oil from sand surfaces, often resulting in increased oil recovery.

Reports from several other water floods, already using Armour cationic chemicals to inhibit corrosion and combat bacteria, also reveal this additional, important benefit. In many instances these chemicals decreased injection pressures by lowering surface tension and dispersing foreign materials.

In many water floods, the action of Armour cationics have prevented scale deposits. The detergent and bactericidal effects of Duomeen® CD-50, Armac CD-50, Duomeen CDA-50 and Arquad T-2C have improved back-washing efficiency of all types of filters. The use of these chemicals ahead of the filters increases filter efficiency—especially diatomaceous earth filters.

For more than 8 years Armour chemicals for oil production have been used in oil fields all over the world. The most successful water-flood units are today using Armour cationics for *complete* bacteria control and as high as 99.5% corrosion protection. Through the years these same chemicals have demonstrated their ability to lower injection pressures, making them of even greater value to the oil industry.

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EXPLORATION PROBLEMS IN PERU

The oil is there, concessions are readily available, and terms are favorable — but exploration problems posed by terrain, climate and wildlife present a real challenge

—*Photos courtesy Summer Institute of Linguistics.*

Thatched-roof houses such as this in Yarinacocha are quite typical of huts in the jungle of Peru. The jungle covered plains area of the Oriente region comprises an area similar to that of Texas.

Carlos del Solar B.
Vice President, Manager of Operations
Peruvian Pacific Petroleum Company
Lima, Peru

AT THE CLOSE of the year 1863 near the town of Zorritos, on the northern coast of Peru, a young civil engineer by the name of A. E. Prentice reached the depth of 80 ft with his rudimentary cable tool rig and completed the first oil well in Peru. This event took place only four years after the Drake well in Pennsylvania and is believed to be the second producing well in the world. This event, unimportant as it might have seemed then, was the starting point of the Peruvian oil industry. By the year 1866 three more flowing wells had been drilled in that area producing together about 480 bbl per day.

In reality the Peruvian oil industry goes back to the days of the Inca empire. These Indians found many uses for oil and asphalt drawn from seepages in various parts of the country, particularly in La Breita, near Talara.

Until recent years the development of the industry was confined to the

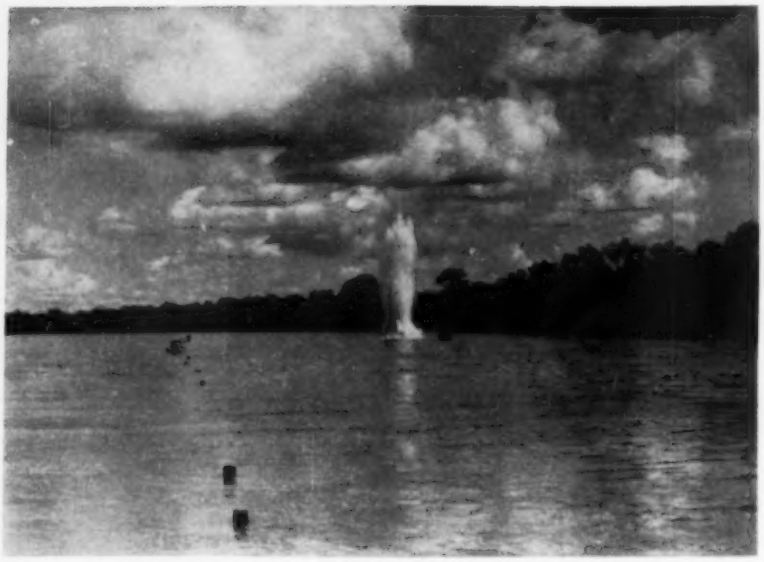
A small settlement on the winding Pachitea River. Note the rugged terrain. Although equipment can move many miles up Peru's many navigable rivers, transportation into the interior presents major jungle-clearing and road building outlays.

coastal region between the Ecuadorian border and the Chira River where several companies, mainly International Petroleum Company Ltd., Compañia Petrolera Lobitos and Empresa Petrolera Fiscal, now produce a total of about 50,000 bbl a day. In the Andean region, although seepages of oil and particularly of asphalt are numerous, the only operation worthy of mention was the minor development of the Pirin area, near Puno, by the Titicaca Petroleum Company in 1905, which drilled 12 wells and produced a very heavy type of oil. The field was finally abandoned but later Empresa Petrolera Fiscal drilled Well RH-1 at an altitude of 13,097 ft, thus taking the credit for spudding the highest well in the world. Nevertheless the operation was again abandoned.

The Oriente or jungle region of Peru is by far the most attractive prospect, since it constitutes the largest remaining unexplored basin in the world. Because of the many difficulties, such as the terrain, accessibility and climate, very little was ever done in the area until Ganso Azul successfully drilled in 1939 its first well near Pucallpa on the Agua Caliente dome, with an initial production of 700 bbl per day. The company has expanded to a daily production of about 2000 bbl. It has a small refinery, supplies the Peruvian Oriente with gasoline, petroleum and diesel oil, and exports some crude to the Manaos refinery in Brazil.

A long period of inactivity followed until the new oil Law No. 11780 was passed in March 1952, coordinating modern petroleum legislation and opening up the field on the basis of equitable taxation with the assurance that concessionaires would be protected during the term of their concessions from any increase in such taxes.

Petroleum Law 11780 divides the country into four zones: Coast, Sierra, Oriente, and Continental Shelf, stressing facilities and lower taxes on the Oriente and Sierra. Concessions may be obtained in open areas by any bona fide concern, national or foreign. Except for the offshore, there are no drilling obligations. Exploration terms vary from 3 years on the Coast, extendable to 5, to 6 years in the Oriente, extendable to 10. Drilling and geophysical equipment may be brought in under temporary exoneration of duties. Surface taxes are equitable and income tax is 50 percent of net profits, except in the Sierra and Oriente, where it starts with 10 percent of the net for the first 10 years of exploitation, 25 percent for the next 10 years, 35 percent for the next 10 years and then 50 percent for the remainder of the concession term. Depletion in the Sierra and Oriente is 27½ percent, but in the Coast and the offshore it is 15 percent for foreigners and 25 percent for nationals.



Shooting in the Marañon River, near the mouth of the Pastaza River. Geophysical Service, Inc., is conducting this operation.

Exploration Activities

At present there are 15 companies operating in Peru dedicated with varying intensity to exploration and development.*

In the coastal zone most of the large acreage held in the Sechura Desert has been renounced, although Texas, Gulf, International Petroleum, and other companies still retain a few small concessions.

North of Talara Peruvian Pacific and Petrolera Amotape have operating agreements with Empresa Petrolera Fiscal.

In 1954 several companies initiated programs of intense exploration in the coastal zone on concessions obtained through Law 11780. These included seismic and gravity surveys and the drilling of several wells in the Sechura, in the Tablazo area and in the Continental Shelf. The negative results obtained in the entire Sechura region, with the exception of the Mirador concession, North of the Chira River, halted exploration activities in that area. In Mirador, Petrolera Peruana, a national company, has drilled several successful wells and now has a production of about 400 bbl per day. In the Tablazo and Amotape sections, and to a smaller extent in the Douglas concessions in the Continental Shelf, a few wells yielded some production. Not much activity has been shown in 1957, with the exception of an intensified

*See story beginning on A-21 for table on Petroleum Concessions in Peru.

THE AUTHOR

Carlos del Solar B., *although a native of Peru, was graduated as a geologist from Harvard in 1929. He later obtained a doctorate in geological sciences (PhD) from the University of San Marcos in Lima. Solar has worked as a geologist for Cities Service Company in Europe and spent several years in France, Germany, Rumania, Hungary, and Yugoslavia. He returned to Peru and worked as a mining geologist until he joined Richfield in 1951. He later joined Peruvian Pacific Petroleum Company and is now vice president and manager of operations. He has also taught geology for the past 20 years at the Catholic University of Lima and at the University of San Marcos where he is now full professor of structural geology and economic geology.*

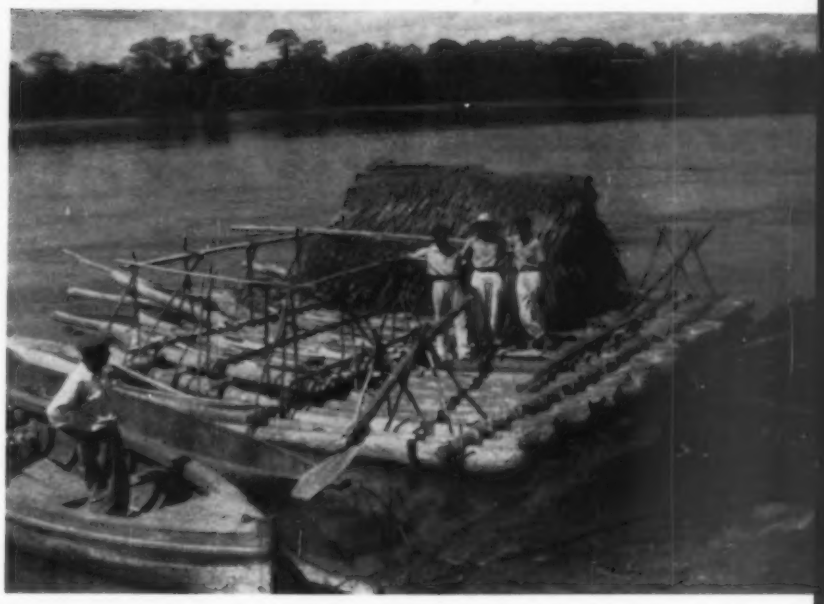
program of International Petroleum Company in conjunction with Compañia Petrolera Lobitos.

In the Oriente a large program of aerial photography including most major companies, was started in 1954 and is now near completion. Texas, in connection with other companies, made a seismic survey in the Marañon and Huallaga rivers, and Mobil Oil and Peruvian Pacific carried on aerial magnetometer surveys. Further seismic work is being done in the Pucallpa and Aguaytía area by several others.

All the major companies have been sending geological parties to the Oriente during the last three or four years.

As for drilling, Texas drilled three unsuccessful wildcats on the banks of the Marañon River. Two dry wells were drilled in Santa Clara (Ucayali) by Peruvian Oils and Minerals and Ganso Azul, and several wells were drilled in the Maquia area (Ucayali) by Compañía "El Oriente." Of these at least three have been successful, each producing about 600 bbl per day.

For 1958 several companies plan to complete the aerial photography of their concessions and do some seismic work. Two or three plan to drill wildcats before the end of the year.



Food and supplies find cheap, although slow, transportation down the Ucayali River in balsa rafts such as these.

Exploration Problems

The Coast. On the Coast exploration for oil is relatively simple in that the region is easily accessible from abroad and from any city or port on the coast. Talara has two excellent airports with first-class international service. There are also local airlines which schedule daily service between Talara and other cities on the Coast of Peru, with connections at Chiclayo, Trujillo, and Lima for the Oriente. Port facilities in Talara permit the docking of large vessels and passenger and cargo ships from the East and West Coast of the United States and from Europe stop there frequently. Good roads along the entire coast permit efficient and cheap transportation.

With the exception of a few dry canyons, the northern coast of Peru is a flat desert with the well-paved Pan American highway running along the shore and a well-spread net of good roads crossing the oil fields. Besides, the surface of the desert is such, that most areas devoid of roads, can be traveled either by car or jeep.

Labor is adequate and efficient drilling crews may be easily procured.

One of the outstanding advantages of northern Peru from the point of view of oil exploration, is the lack of vegetation in most of the area, which makes outcrops very conspicuous for easy identification both on the ground and with aerial photographs.

Aside from the slowness in obtaining equipment and replacements from foreign countries and the lack of certain facilities inherent to highly industrialized areas, it may be said that the coast of northern Peru offers problems in exploration similar to those encountered in Southern California.

The Continental Shelf. Geologically the Coast of Peru is considered one of emergence. Disregarding the presence of the ocean, the elevation between the higher Peruvian Andes, up to 22,000 ft in the White Range, and the bottom of the ocean, as much as 28,000 ft, represents a difference in elevation of about 50,000 ft, which is by far the greatest known. This means that the Continental Shelf falls off very rapidly close to the shore, reaching maximum depth 20 to 30 miles from shore. Peru, therefore, has a very narrow offshore range and, with present day technique, drilling must be confined to strips close to the coast. With the recent development of drilling from barges, a fair estimate of a maximum drilling distance from shore is probably six miles. As far as directional drilling is concerned, the several Douglas wells, near Lobitos, presented no serious problems.

The Sierra. Only near Lake Titicaca has any drilling for oil been undertaken. The chief difficulties encountered were those brought about by high altitudes, around 13,000 ft, and by poor transportation due to deficient roads. Since no wells have been drilled there for several years, trained personnel is lacking in that area and would have to be brought from other fields.

As for surface geology most of the Sierra is quite barren and formations can easily be studied.

The Oriente. The Oriente of Peru presents very difficult problems in the exploration for oil, most of which are typical of those found in other jungle regions of the world. However, the Amazon Basin presents certain peculiarities which deserve careful consideration.

Improperly called "The Montaña," this jungle comprises an area of approximately 75 million hectares, or 300,000 sq miles, an area larger than the State of Texas. From the topographic and climatological points of view it may be divided into two separate sections: (1) The highlands which start at the southeastern border of Ecuador, follow the eastern flank of the Andes in a south-eastern line through the region of Moyobamba, Tarapoto, Tingo María, Oxapampa and Satipo, and then turn east near the valley of the Urubamba following the southern part of Madre de Dios as far as the Bolivian border. This strip varies in width from 75 miles on the northern part to about 100 miles toward the center and south, (2) the flat plains which comprise the entire territory of Peru, east of the above strip.

1. **The Highlands** range in altitude from about 800 to about 3500 ft. They are formed by rolling hills in certain sections and abrupt canyons in others. Vegetation is thick at the lower altitudes gradually changing into more open forests and grazing lands higher up. The climate is decidedly tropical

Texas house boat, one of two, used by seismic parties stationed along the rivers, fill multiple purposes. It provides lodging, transportation and a mobile base of operations.

with the rainiest season lasting from November until April. Temperatures do not vary much during the year and range from a minimum of about 72 F in the early morning to a maximum of about 100 F in the early afternoon. Relative humidity ranges from 60 to 95 percent being higher in the lower zone. Rainfall in the highlands ranges from about 40 to 120-in. per year.

Transportation to these upper parts of the jungle is very difficult. There are a few roads but most of the personnel, food and equipment has to be transported by plane or by river. For example, there is a good road from Lima to Pucallpa, on the Ucayali River, over which a great deal of cargo is sent to supply that region and then shipped by boat down the Ucayali River to Iquitos. Other rather important towns, such as Yurimaguas and Tarapoto are not connected with the coast by road. Tarapoto's cotton crop is sent to Lima by plane, and the town, which has a population of not more than 20,000 inhabitants takes pride in having the second most important commercial airport in Peru.

One can easily see the obstacles in carrying on exploration work in these jungle highlands. A rig could easily be brought from the States by boat all the way to Pucallpa, Yurimaguas, or Tarapoto; the matter of transporting such a rig to the drill site once it arrives at one of the above ports is something else, involving construction of special access roads. As long as there is a navigable river, the problem of transportation is not serious until it becomes necessary to carry heavy equipment across the jungle.

2. **The Plains.** The climate in the flat plains is even more tropical than in the highlands with rainfall as high as 200-in. per year in the rainy season. Relative humidity tends to be higher most of the time and temperatures vary from about 75 to 105 F. This lower part, the flat plains, represents an enormous section of level jungle with large rivers meandering, and changing their courses from season to season. To illustrate the flatness of this peneplain, Borja, at the junction of the Santiago and Marañon rivers, is only about 700 ft above sea level and Iquitos, 500 miles to the east is about 180 ft high. Yurimaguas is 600 ft above the sea and 400 miles, by river, from Iquitos. This drainage plain continues all the way to the Atlantic but is so flat that the large rivers flow only because of the head formed by their great depth and their enormous volume of water. The Amazon flows about 3000 miles from Iquitos to the Atlantic with a gradient of about 1 in 100,000, dumping at the mouth an average volume of 2 billion gal per minute. The speed of these rivers, naturally, varies in accordance with several factors such as gradient, volume, width, etc., but the Amazon near Iquitos, ranges between 1½ and 2 miles per hour.

The rivers that form the Amazon drainage suffer tremendous variations in level between the dry and rainy seasons. In the Marañon, Amazon, and Ucayali a sudden change in level of 10 or 15 ft is not rare. At the Yutopiza, on the right bank of the Santiago a rise of 46 ft in two days was measured last year. These changes result in serious difficulties such as that suffered in 1956 on the Marañon by a company which had to abandon a well and carry away the rig because of the rising level of the river.

Iquitos, the largest town in the Peruvian jungle and the center of operations of most companies, is a pleasant city on the shore of the Amazon with a population of about 65,000 inhabitants. Large ocean-going vessels make regular trips to Iquitos from the States and Europe. For this reason it is often cheaper to transport heavy materials by that route than from Lima. The Amazon at Iquitos is very deep and the ships dock at the shore with ease. Of all the world's ports able to dock large vessels, Iquitos is the fartherest away from the ocean.

Many geological parties have started from Iquitos supplying themselves there with canoes, barges, motors, food, and other equipment. They have traveled up the Marañon as far as Borja, the last navigable point, as a base to study the tributaries of the Amazon and Santiago rivers. The trip from Iquitos to Borja by canoe takes approximately 10 days, although river boats make it in 6 days. Small aluminum boats or very light canoes are always carried in order to enter the smaller streams where geological structures may be better studied. A geological party thus usually consists of a chief geologist and an assistant geologist, a foreman, 2 mechanics, a medical aide, a cook and from 6 to 8 laborers. Equipment consists of a 3-ton canoe, a smaller one capable of carrying between 1 and 1½ tons, an aluminum boat, 2 or 3 outboard motors, food, supplies, spare parts, medicines, etc. for three or four months. This, naturally varies according to the distance, size of area to be covered, etc.

In later years several oil companies have found it more convenient, and even more economical, to avoid the long river trip from Iquitos by using airplanes. In this connection Peru is extremely lucky to be able to utilize the services of the Summer Institute of Linguistics. This organization which has a large camp at Yarinacocha, close to Pucallpa, owns several planes, from small light crafts to a PBY Catalina. The planes are rented at very reasonable rates. They are excellently maintained and the pilots are real jungle veterans. Thus, equipment and supplies may be sent by road from Lima to Pucallpa, a two-day trip, and thence flown to Yurimaguas, Borja or any place along any large river. The saving in time is usually worthwhile and the personnel avoids the tedious river trip. Gasoline, kerosine, lubricants, and any other heavy materials can easily be

sent from Iquitos by one of the many river boats that travel regularly along the Marañon, Huallaga, and Ucayali rivers. There are, of course, several scheduled and non-scheduled airlines which connect these towns.

Life in the jungle is unpleasant but can be made more bearable with good tents, mosquito nets, insect repellants, a good shotgun, a portable radio receiver and plenty of canned food. The laborers' staples are composed mainly of rice, yuca (an edible root similar to a potato), bananas, dry meat, and, last but not least important, paiche. This is a fish very abundant in all rivers, reaching in the Pastaza a length of 9 ft, and a weight of 200 lb. It has a very high protein content, 36.5 percent, compared to the usual 20 percent of most fish and 17 percent of beef. The paiche, catfish, and other species, such as the gamitana are usually eaten after having been dried.

The flora in the Amazon Basin is, of course, very abundant. Undoubtedly this is one of the greatest sources of cellulose in the world. Mahogany, cedar, oak, and innumerable local varieties of hard woods are quite profuse in several regions. Rubber trees, rose wood, cube (the source of rotenone), artificial ivory, and similar jungle species are locally commercialized. One of the outstanding nuisances when crossing the jungle is the thick and abundant undergrowth of vines, ferns and entangled shrubs.

As for the fauna the rivers themselves contain very large amounts of fish ranging from beautiful aquarium varieties such as the neon tetra, to large catfish and, very rarely, a shark. A surprising cetacean intruder in the Amazon is the porpoise which must have come from the ocean and has become a fresh water mammal. Of course, the most publicized fish is the piranha, a small Caratidae usually not more than six inches long. There are several varieties and one, the black piranha, may occasionally reach 18-in. in length. They all have the obnoxious habit of attacking any animal that may be bleeding, even through a small wound. Since they travel in large schools they can readily reduce to bone even a large animal such as an ox. Some varieties are said to attack regardless of whether or not there is blood. Although many stories are told regarding this fish, and many of them are true, the danger of being eaten by the piranha is rather far-fetched. Other notable inhabitants of the river are the alligator, rather harmless and very different from its Asian crocodile cousin, and the charapa, a large edible turtle.

Land animals are much scarcer than most people believe. Several varieties of wild boar, sachavaca (tapir), deer, rabbits, armadillos, and squirrels can be found occasionally. Monkeys are varied and very abundant. Jaguar, pumas, and other felines may also be found but are usually difficult to see.

Biggest danger in the jungle is poisonous snakes. In this regard one must take a sober view of the problem. There are many varieties, such as rattlers, corals, and many local species whose bite may be deadly if not treated quickly and properly; but these snakes all run from man and only bite when stepped on or touched. A person may travel in the jungle for weeks without seeing a single snake or may meet several within an hour. A good snake kit is a must. The famous yacumama or anaconda (eunectes murinus) is without doubt the largest snake known. From excellent authority it is said to reach, when fully developed, a length of between 80 and 110 ft and a diameter of 30-in. For it to swallow a large alligator, or a 400-lb tapir, after being crushed, constitutes no problem. The monster then drinks abundant water and sleeps for several months. It will never attack man unprovoked but may be dangerous if bothered, needless to say.

Birds are abundant in certain regions and range from several species of wild turkeys to doves, guinea hens, and the like.

Insects are so abundant and of so many varieties that it would take a special treatise to describe them. They range from mosquitoes, gnats, moths, fireflies and crickets to chiggers, the worst of all. The latter produce painful welts in the legs unless well protected with boots and insecticidal powders. Insects are not very bothersome during the day, but a mosquito net is essential to keep them away at night.

With the exception of a few small isolated tribes, the Amazon Indians are friendly and never give trouble. The famous headhunters of the Aguaruna and Jibaro tribes, concentrated along the Santiago River, can often be hired as guides, having given up almost entirely their ancient hobby of shrinking the heads of their enemies to the size of an alligator pear.

The Amazon Basin is indeed a difficult region to explore, but is gradually becoming better known and better understood. It may be said that the finding of large reserves of oil is its greatest hope for a thorough development. Nature has handicapped it with serious obstacles, but has also endowed it with resources which may prove extremely valuable for the survival and progress of the free world. It will gradually be conquered by man, for man progresses continually while nature can only fight from its own standpoint. ★

Geologists Fete Award Winners At AAPG Meeting

Recipients of honorary awards were formally named at the 43rd annual meeting of the American Association of Petroleum Geologists in Los Angeles, March 11.

Sidney Powers Award

Paul Weaver, professor of geology, Texas A & M College, received the Sidney Powers Memorial Medal in recognition for his outstanding contributions to, and achievements in petroleum geology. The presentation was made by Ray R. Morse, consulting geologist of Houston, Texas.

Weaver, who received his AB degree at Columbia University in 1908, first worked for the United States Coast and Geodetic Survey. He joined the staff of the United States Geological Survey in 1909, and a year later went to Venezuela with the Bermudez Company. In 1912 Weaver worked for the S. Pearson & Son Company in Mexico and London. He returned to Mexico in 1915, this time with the C.M.P. Aquila Company. In 1926 he became superintendent in charge of drilling and production, for the Gulf Oil Corporation in Houston, and in 1951 he was technical assistant to the vice-president. Upon his retirement from Gulf in 1953, Weaver became a Distinguished Research Geologist for the Texas A & M College.

Honorary Memberships

As a symbol of distinguished services performed in the field of petroleum geology, certificates of Honorary Membership were presented to:

Carroll Edward Dobbin, regional geologist, U.S.G.S., Denver, Colorado, by J. V. Howell, consulting geologist of Tulsa, Oklahoma;

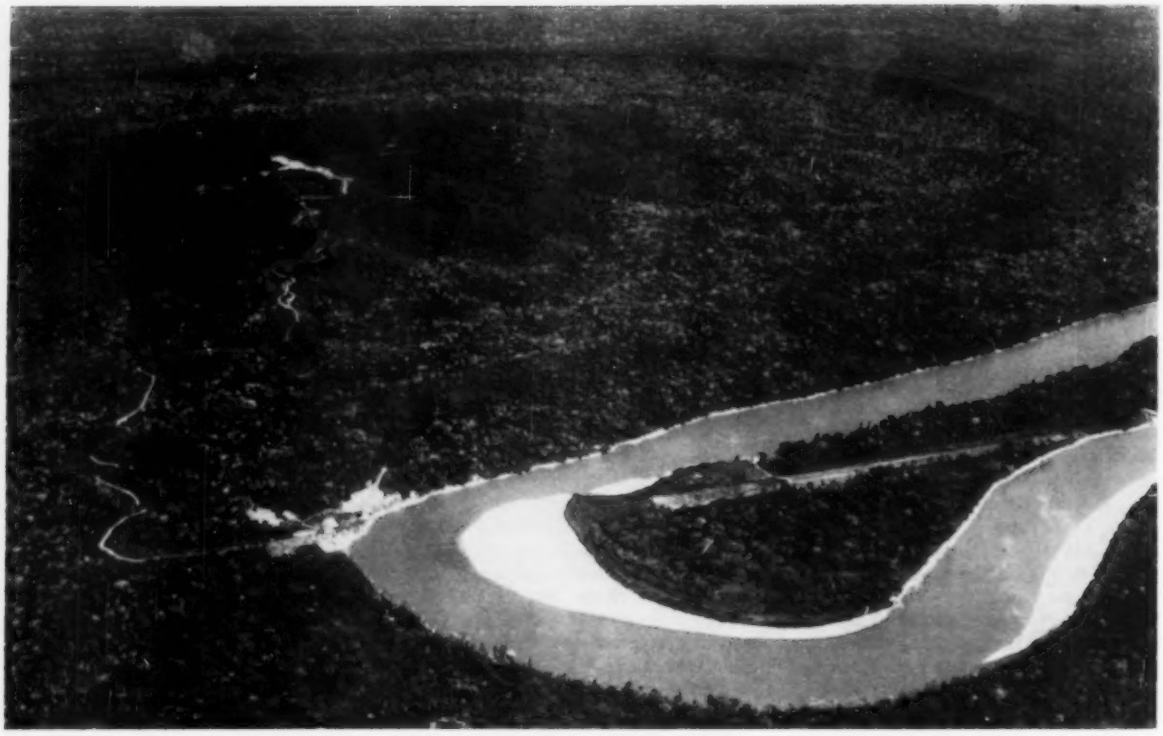
K. C. Heald, petroleum consultant, Fort Worth, Texas, by M. Gordon Gulley, Gulf Oil Corporation, Pittsburgh, Pennsylvania;

William Bayard Heroy, president, the Geotechnical Corporation, Dallas, Texas, by A. Rodger Denison, Amerada Petroleum Corporation, of Tulsa;

A. I. Levorsen, consultant, Tulsa, by Paul E. Fitzgerald, Dowell Incorporated, of Tulsa;

Raymond C. Moore, principal State geologist, Lawrence, Kansas, whose presentation was made by K. K. Landes, University of Michigan, Ann Arbor, Michigan; and,

Wallace E. Pratt, consulting geologist, Carlsbad, New Mexico, by L. T. Barrow, Humble Oil & Refining Company, of Houston.



The Ganso Azul dome in the Amazon basin is clearly defined in this aerial photograph by the outcropping ridge of Upper Cretaceous sandstone. The field and camp are located on top of the dome.

Three distinct areas define . . .

GEOLOGICAL FEATURES OF PERU

Dr. J. E. Rassmuss,
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Of Peru's three oil provinces, the coastal area is still the principal commercial producer, but the vast Amazon Basin encloses one of the largest prospective areas in South America

PERU is physiographically divided into three principal areas: The coast, the Andes Mountains and the Amazon Basin. Due to the cold Humboldt stream, flowing from the Antarctic, the Peruvian coast is extremely dry and is inhabited only where the rivers from the Andes to the Pacific provide water for irrigation. The high barrier of the Andes Mountains encloses Peru's rich mineral resources. The Amazon Basin, due to its heavy precipitation, is covered by an impenetrable jungle and is accessible only by the rivers, tributaries of the Amazon which flows over 3000 miles to the Atlantic. In Peru it is called Montaña, which means forested country.

These three areas of different geological structure enclose three distinct petroleum provinces.

The Coastal Area

The coastal area is the only province so far proved important for petroleum production. Principal oil fields of Peru are located on the Tertiary

coastal plain on the northernmost part of Peru's coast between about 5 deg and 3 deg southern latitude, extending from the Chira River in the south to near the boundary of Ecuador in the north.

The coastal plain, 12 to 20 miles wide, is built up by the deposits of the Tertiary shelf on the foot of the Amotape Mountains toward the Pacific. The Amotape Mountains to the east are composed of Paleozoic slates and quartzites, in which fossils of Pennsylvanian age occasionally are found, and intruded by granite. At the foot of the Amotape Mountains and in larger extension to the east, Cretaceous deposits also are exposed. These deposits enclose in their lower section dark bituminous limestones called Muerto limestone, of Aptien to Albien age, which correspond to the Lower Cretaceous limestones of Colombia and to the Cogollon limestone of Venezuela. They have a pronounced odor of oil and are strongly bituminous, but are only about 500 ft thick and have not proved so far to contain commercial oil deposits.

Upper part of the Cretaceous section is of Senonian to Danian age, overlying in unconformity, and is composed principally of shales with intercalated sandstone and conglomerate beds. The Danian section is composed of the Mal Paso shales, which enclose lenticular sands in the lower part and have yielded modest production in the Brea-Parinas field in several wells of International Petroleum Company.

The Tertiary sequence of the coastal plain of Eocene to Miocene age shows an alternation of marine shales and clays and sandy to conglomeratic beds, corresponding to the different transgressions and regressions on the oscillating marine shelf. This sequence offers, by the alternation of permeable beds and impermeable cap rocks favorable conditions for oil accumulation.

Eocene deposits. The Eocene deposits which attain about 15,000 ft thickness, thin out eastward to the Tertiary coast of the Amotape Mountains, changing in their facies to littoral and shoreline sediments. They also thin out to the north and in two exploration wells of Empresa Fiscal near Zorritos at 1671 and 1402 meters depth the Oligocene Mancora sandstones and conglomerates overlie immediately the granite of the basement.

In the Lower Eocene the sand lenses in the Negritos and Salinas formation yield considerable oil production. In the overlying, predominantly dark shales of the Pale Grade section, intercalations of dense sandstone are less productive. Over 70 percent of the total production of International's Brea-Parinas field proceeds from the overlying Parinas sandstone, which is up to 1000 ft thick. It crops out at Parinas point, the westernmost cape of South America, and frequently contains pieces of silified wood, classifying it as a shallow water deposit. The Parinas sandstone becomes gradually more shaly northward and correspondingly poorer in oil and disappears in the latitude of Quebrada Mancora at the northern limit of the concessions of Cia. Petrolera Lobitos. The Parinas sandstone is covered by the Chacra shales as a cap rock, which constitutes the uppermost member of the Lower Eocene section.

In the Middle Eocene section the Talara formation, which increases in the Organos field to about 3000 ft thick, is one of the principal oil producing horizons in the northern fields. It is covered by the Pozo shales.

The overlying Verdun sandstones are oilbearing in the Brea-Parinas field, yielding about eight percent of the output, and they have proved oil bearing also in the northernmost part of the Eocene belt in the concession of Petrolera Amotape. They are covered by the Chira shales, in whose upper part conglomerates also occur.

To the north, the Eocene deposits are cut in a sharp unconformity by the transgression of the Oligocene Mancora sandstones and conglomerates. These formations overlie, in the Zorritos region, the granite of the basement.

The Mancora section is overlain by the shales and argillites of the Upper Oligocene Heath formation, in which oil seepages occur south of Zorritos at Hervideros. No commercial oil has been proved in this section.

In the old Zorritos field where drilling started in 1865, a few years after the Drake well in Titusville, oil is found in the Miocene Zorritos sandstones which are covered by the Cardalitos clays and the Tumbes sandstone. Zorritos field has yielded about 4,000,000 bbl of oil, but is today almost completely depleted, producing only about 30 bbl per day. Origin of the oil in Zorritos is certainly secondary, possibly immigrating from Eocene deposits buried in the ocean, but continuing northward below the sea to the Ecuadorian oil fields of the Santa Elena peninsula.

North of Zorritos in the Tumbes area, where the Upper Tertiary deposits, according to geophysical surveys, increase newly in thickness, marine Pliocene layers are also exposed. But no oil has been proved in this section.

Physical geology. One striking phy-

Maquia No. 1, discovery well of the Maquia field in the Amazon Basin, tested at 500 bbl per day from the Upper Cretaceous "sugar sandstone."

siographical feature in the coastal fields is the broad Quaternary marine terraces, extending locally far into the interior and cut by dry valleys, in which the Tertiary beds are exposed. Epeirogenetic movements still continue on the coast, and in the Sechura desert, a recent warping can be clearly observed with three pebble beaches near Colan in the north indicating the retiring of the sea and a slight uplifting. In the south, the sea invades the Vir-

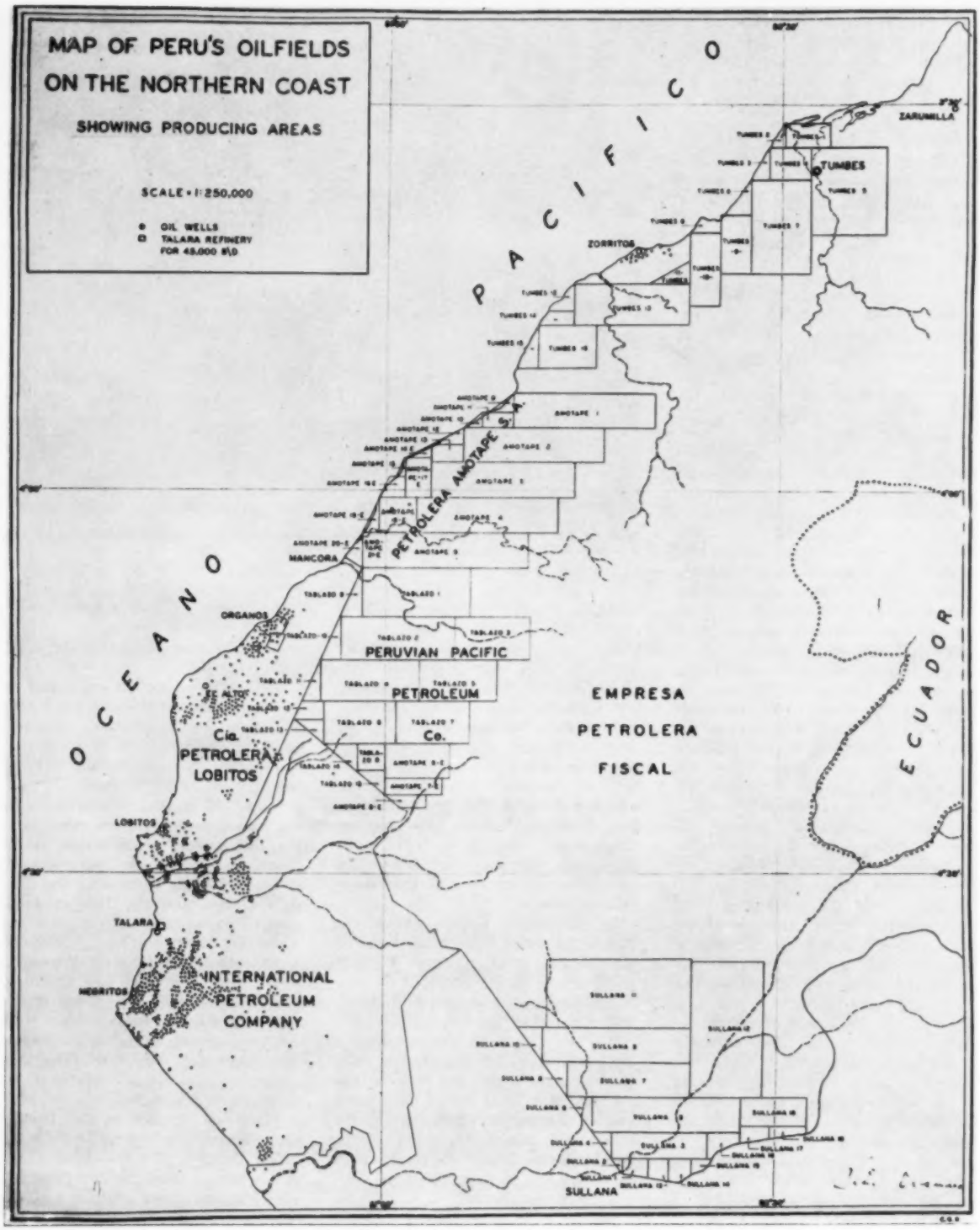

FIG. 1. **Peru's northern coastal area** contains the country's principal oil fields. This map shows the larger fields, concessions, and major oil companies operating in this region.

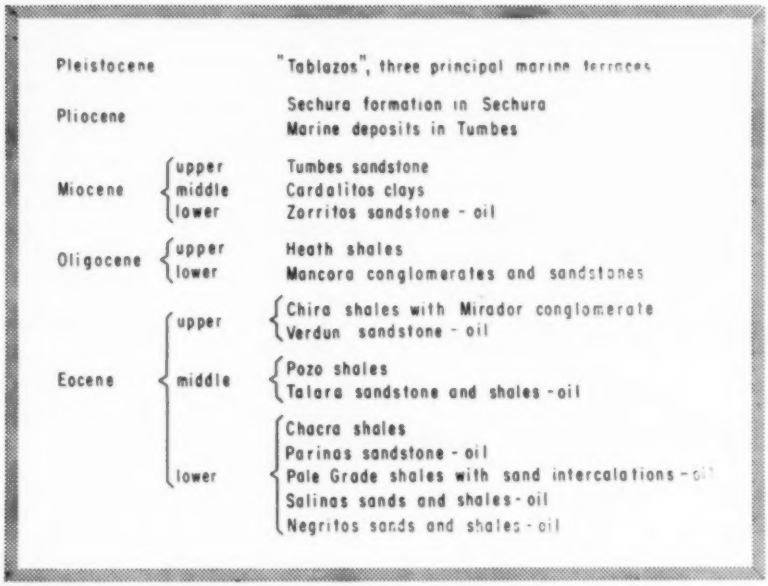

FIG. 2. **General geological column** of the Tertiary deposits in the coastal area of Peru. The most important petroleum production in Peru is from this area.

rila inlet and the salt marshes farther southeast of Reventazon are sinking to about 80 ft below sea level, protected only by the sand dunes of the coast.

The structure of the coastal fields is defined by large anticlinal uplifts which are broken by numerous faults and shattered into hundreds of smaller blocks, produced by the strain from the deep Pacific graben in the ocean to the west and the uplifted Cordillera to the east. In the Brea-Parinas field, direction of the uplifts is approximately east-west and is related by some geologists to pre-Tertiary structures. But in the north, striking of the structures is northeast-southwest, parallel to the Cordillera and to the coast, and in both broken by numerous parallel and transversal faults. The oil accumulations are dependent from the structural uplifts of the larger structures in general and the crests of the local blocks in detail.

Production history. Cumulative output of the coastal fields until January 1, 1957, amounts to around 500 million bbl of crude oil plus some 30 million bbl of condensate. Present yield is about 50,000 bbl per day plus 3000 bbl per day of condensate. Present number of producing wells in the coastal area is around 3150 with an average yield per well of about 16 bbl per day.

Principal field of the coastal area is the Brea-Parinas field of International Petroleum Company, more than 60 years in exploitation and almost depleted. But by secondary recovery, waterflooding and sand fracturing, production is maintained at around 28,000 to 29,000 bbl per day and amounted in 1956 to 28,480 bbl per day. Cumulative output, including 1957, reaches nearly 400 million bbl.

Second in importance are the fields of Cia. Petrolera Lobitos, subsidiary of Lobitos Oilfields, Ltd., of London. Total production from Lobitos fields amounted in 1956 to 17,899 bbl per day. Cumulative output exceeds 100 million bbl. In May 1957, International Petroleum Company acquired a 50 percent interest in Cia. Petrolera Lobitos, which still holds considerable oil reserves, and undertook the entire operation of its fields. Total production by International in 1957, including its 50 percent share in Lobitos, increased to 12,867,710 bbl in total and the Lobitos Company alone yielded 4,343,603 bbl in 1957.

Empresa Petrolera Fiscal, the government-owned company constituted in 1936 by the purchase of the Lobitos field and the Organos concessions from the former private owners, gets the bulk of its present production from the Organos field. Minor production comes from the old Zorritos field and the Sector Peru in the southwestern corner of Empresa's concession. Total production amounted in 1956 to 741,525 bbl.

Empresa has leased two areas of its concessions to two foreign companies. The Tablazo concessions, located east and to the interior of Lobitos Company's area, and the Tumbes concessions, located on the coast, north and south of Zorritos, were leased to Peruvian Pacific Petroleum Company, a subsidiary of Cities Service and Richfield Oil Corporation. Peruvian Pacific drilled a total of nine wildcats in the Tablazo concessions and got two producing wells, which yield at present about 150 bbl per day together. Oil was found in the Mogollon conglomerate, a shoreline facies of the Lower Eocene Salinas formation. A six-mile pipeline connects the wells with Empresa's field.

The coastal strip, adjoining Lobitos' concessions to the north, was leased to Petrolera Amotape, an independent American company. Amotape drilled two wells to the Verdun sandstone, which was found to be productive. The company holds some other concessions, located north of International and its Coyonitas structure.

South of the Chira River on the coast, adjoining International's Brea-Parinas field to the south and on the southern extension of its Portachuelo structure, Cia. Petrolera Peruana, a national company, drilled 10 producing wells to the Salinas formation. Total output in 1956 amounted to 187,716 bbl, but declined to 153,137 bbl in 1957 when drilling was suspended.

Peru's total production from its coastal fields increased in 1957 to nearly 18.5 million bbl. Outlook for increasing the output relies on a more active development of the Lobitos fields by International Petroleum Company, which has taken over the operations and proposes to invest $40,000,000 in further development. The northern area also offers undeveloped prospects, particularly along the coast north of the Lobitos concession.

South of the Chira River the coastal plain broadens in the Sechura Desert to about 60 miles in width. The Sechura Basin is surrounded on the west to the Pacific by the hills of the Silla de Paita and the Cerros Illescas, both composed of paleozoic rocks and intrusions of granite. They constituted islands in the Tertiary sea, as indicated by the Tertiary shoreline deposits on their foot, and were connected by a submarine swell with the Amotape Mountains to the north, as proved by the wildcat Paita No. 1 of Union Oil Company, which hit basement at 1282 ft. The old rocks continue to the south in the Lobos Islands. Sechura Basin was divided by this ridge from the Tertiary shelf and constituted a separate, relatively shallow basin, in which the Eocene deposits were either deposited in reduced thickness or removed by later uplifting and erosion. Only marine Miocene and Upper Tertiary deposits are developed in greater thickness, but these have not so far proved oil bearing in Peru's coastal area. Fifteen wildcats drilled by International, Richmond, Texas, Gulf and Union Oil were dry and generally struck basement at moderate depth.

THE AUTHOR

Dr. Juan E. Rassmuss *studied in Germany and Switzerland, receiving his PhD degree in geology from the University of Berlin. He was first contracted by the Argentine government and worked many years in Argentina and several other South American countries, particularly in Peru. He returned to Europe to become manager and member of the board of an oil company in Rumania. After the entrance of the Russians in Rumania he returned to Peru and conducted surveys of Peru's oil resources for the Peruvian government and made surveys of Bolivia's oil fields for YPBF, the government's oil enterprise. He serves at present as an independent consultant on South American oil development and geology with offices in Lima.*

In southern Peru in the Pisco region, about 150 miles south of Lima, Tertiary marine deposits are newly exposed on the coast. Upper Eocene fossiliferous marine shales, sands, and limestones outcrop on the Paracas peninsula, overlying Paleozoic rocks and porphyrite, and extend on the coast to the south, but are generally divided by parallel faults in narrow tilted blocks parallel to the coast.

Miocene diatomites, contemporaneous with the Monterrey shales of California, outcrop north of Pisco and continue to the south to the hills of Ocucaje. The thin cover of these Tertiary deposits over mostly metamorphic and igneous rocks and the lack of an impermeable cap rock on the Miocene diatomites, which would have offered a proper reservoir rock, exclude the presence of commercial oil accumulations. A wildcat drilled in 1955 by International Petroleum and Sea Oil was dry, hitting basement at 3126 ft, and any further exploration has been abandoned.

A narrow Oligocene ingression has been described in the Camana region farther south.

The Andean Belt

In the mountain belt of the Andes ridges, bituminous limestones occur in the Cretaceous section and asphaltite veins, crossing the beds, are often observed. They are locally exploited for their vanadium content, but the strongly distorted tectonical structure has prevented any commercial oil accumulation. Only in two regions, in the Brea de Chumpi, inland of Chala, and on the western border of Lake Titicaca, near the southern frontier with Bolivia, strong seepages are found.

In the Chumpi region at Huatum Brea Cretaceous limestones, folded and faulted, are strongly impregnated with oil and fissures and hollows filled with tar. On the water of a small creek emanations of gas and patches of oil are observed. Oil from these source-beds has been distilled by igneous intrusions of neovolcanic activity and has immigrated to permeable tuffitic and agglomerate beds exposed at Brea de Chumpi. Several tunnels have been drilled into this material and the tar recovered by local miners. However, no commercial oil accumulation can be expected since the petroliferous limestones and the impregnated tuffbeds are exposed by erosion to the air, and the lack of cap rock has prevented the accumulation of oil.

On the western border of Lake Titicaca at an altitude of around 13,000 ft from shallow wells drilled about 70 years ago, almost 300,000 bbl of oil have been recovered in this highest oil field of the world. Cretaceous deposits of shales, sandstone and intercalated limestones cover in an erosional unconformity fossiliferous slates, sandstone and grauvacke of Middle Devonian age. On the anticline of these Devonian beds, the Southern Railways drilled three dry wells. The Titicaca lake corresponds to a tectonical interandean depression, or graben, and the Cretaceous and Tertiary beds on its western flank south of Pirin are folded and overturned and strongly distorted. On this strongly disturbed monoclinal structure, the Peruvian Government drilled 13 wildcats without success, one of them yielding some 60 bbl of oil. In the less disturbed, block-faulted zone to the west, small accumulations of oil could be expected, but no bigger commercial production is probable in this marginal region.

The Peruvian oil law of 1952 considers the mountain belt or "sierra" as a separate prospective oil zone with lower taxes and longer exploration terms.

The Amazon Basin

The Amazon Basin, or Montaña, is considered the biggest oil prospect of Peru. It is covered by the largest concession area in South America, exceeding 30 million acres. The favorable conditions of the new petroleum law of 1952, low taxes, exploration terms to 10 years, depletion allowance of 27½ percent and, particularly, the granting of large areas, have attracted a large number of companies which now total 16, including the five majors. Besides American, Peruvian, and Canadian companies, a syndicate of three German oil companies is also actively engaged in this country.

Difficult access to the jungle-covered country and the high barrier of the Andes to the west permits shipping of heavier material only over the Amazon River, 3000 miles long, from the Atlantic. This relative isolation presents serious difficulties for fast development. Every foot for the surveying geologist, outside of the rivers, must first be cleared in the dense jungle. Geological knowledge of this vast region is therefore still very incomplete, although the private companies have assembled a considerable amount of information not generally available.

Historical geology. Shales with graptolithes of Middle Ordovician age represent the oldest fossiliferous deposits known so far in the Montaña. They outcrop in the Contaya Mountains in the middle Ucayali region, near the Brazilian boundary. They overlie in the Contaya dome quartzitic sandstones of possibly Cambrian age and are covered by transgressive Lower Cretaceous sandstones.

Devonian neritic to littoral deposits, principally sandstone and grauvacke with trilobites, are exposed only on the southwestern border of the Montaña near Lake Titicaca, in the Andean oil province. But permocarboniferous marine limestones with fusulinas are known from Madre de Dios in the south to Ecuador, where they correspond to the Macuma limestones and shales. In the discovery well of Ganso Azul they were found at 1457 ft and are underlain by hard sandstone, possibly of Pennsylvanian age, covering granite of the basement at a depth of 5129 ft. Hard sandstones found in the Coninca No. 2 wildcat of El Oriente Company on the Pisqui River below 8500 ft may be of similar age.

Deposits of Devonian or Mississippian are so far not known in the Peruvian Montaña, although they have been encountered in the Nova Olinda wells in the Brazilian Amazon Basin. Devonian shales and sandstones are widespread in Bolivia's oil fields, being the principal source-bed.

Limestones of Upper Triassic age, containing ammonites of the Noric sec-

tion, have been described from the northern part of the Eastern Cordillera south of Chachapoyas. However, Triassic deposits are not known in the Montaña proper which was probably a land mass during this period.

On the eastern slope of the Cordillera from the upper Maranon in the north to Madre de Dios in the south, 21 salt domes have been described. They are reported to contain at Chasuta inclusions of Liassic limestone, but their definite age has not yet been established.

Lower Jurassic limestones, containing Liassic arietites, are well developed in the Huallaga region. The Upper Jurassic Chapiza formation, composed mostly of reddish sandstones and shales and pyroclastic deposits, outcrops in several places from Rio Santiago on the upper Maranon to the Huallaga and Pisqui rivers in the Middle Ucayali, and in the south at the Pongo de Mainique on the upper Urubamba River. The Chapiza formation has also been found when drilling the wildcats at Canchahuayo and Sta. Clara.

Orogenetic movements of the Nevadian stage at the end of the Jurassic period are recognized in the widely extended unconformity of the overlying Cretaceous deposits. The Lower Cretaceous sandstone, called in the Ganso Azul region the Agua Caliente sandstone, overlies Ordovician shales east of the Ucayali River in the Contaya dome.

The Cretaceous sediments in the Montaña have been deposited in an epicontinental basin on the western border of the Brazilian shield. Transgressions and regressions from the Andean geosyncline have produced an alternation of marine shales and limestones with shallow water and littoral sandstones, which attain considerable thickness. These sandstones represent favorable reservoir rocks for accumulation of oil, and the only oil deposits discovered so far in the Montaña have been found in the Cretaceous sandstones.

Cretaceous deposits in the Ucayali Basin, the only region where commercial oil has been proved, are divided in a lower sandstone group called Agua Caliente sandstone, a series of limestones and shales called Chonta formation and an upper sandstone called "sugar sandstone" due to its light color and grain. Ganso Azul oil is accumulated in the lower sandstone group and the Maquia oil in the upper sandstone.

Overlying Tertiary redbeds, composed principally of reddish argillites and silts with intercalation of sandstones and rare lime beds, are predominant in the lower parts of the Amazon Basin, reaching a total thickness of about 10,000 ft and comprising the Eocene to Miocene period.

In Iquitos and Pebas, in the most northeastern portion of the Peruvian Montaña, slight warped Pliocene clays with intercalations of lignite constitute the uppermost section of the Tertiary sequence.

According to our present knowledge, marine deposits are represented by the Ordovician shales, the Permian bioherm limestones, the Lower Jurassic limestones and shales and the Cretaceous shales, limestones and shallow water sandstones. They can be considered as possible sourcebeds for oil. In the Devonian, Mississippian, Triassic, and Upper Jurassic continental conditions seem to have prevailed. Tertiary redbeds constitute shallow water, river and subaerial sediments, in which secondary, immigrated oil accumulations could be expected.

Production history. Commercial oil has been discovered in the Ganso Azul dome and on the Maquia structure, both located in the Ucayali Basin. Ganso Azul field was discovered in 1939. The rich, partly coarse oil sands are found at an average depth of 1000 to 1200 ft in the Lower Cretaceous Agua Caliente sandstone which outcrops on the top of the dome. Twenty wells have been drilled, but drilling was interrupted for several years due to lack of transportation facilities. Output in 1957 amounted to 780,330 bbl, varying from 2000 to 3000 bbl per day. Cumulative output including 1957 amounts to around 3,140,000 bbl. Gravity of the crude is around 44-45 deg API.

A 48-mile pipeline connects the field with the river port of Pucallpa on the Ucayali River. Crude is shipped by Transportes Amazonicos, the holding company constituted by Texas Gulf Producing Company of Houston, by barges on the Amazon River to the new refinery in Manaos-Brazil and to the government refinery at Iquitos. An 1800-hp tugboat is employed for the transport to Brazil, which pushes four barges carrying 12,000 bbl each.

Drilling on the second structure on Chonta Island has been unsuccessful with a well abandoned at 2197 ft in the Permian limestone. On the Ganso Azul dome itself, Well No. 1, when recently deepened, struck granite of the basement at 5129 ft after drilling through a large thickness of the Permian limestone and some possibly Pennsylvanian sandstone.

Some 100 miles north, east of the Ucayali River near Contamana, oil was found in March 1957, on the Maquia structure by a German syndicate of Elwerath, Wintershall, and Deutsche Erdoel, associated with the Peruvian company El Oriente, holder of the concession. Five producing wells have been drilled, and the first three, located on the crest of the structure, proved 500 bbl per day each of 38 deg API crude. Oil is found in the Upper Cretaceous "sugar sandstone" at about 2100 to 2200 ft. In the last Maquia well, No. 6, oil has been found in a higher sand at about 1740 ft. Market conditions are similar to Ganso Azul and the crude could be shipped to the Manaos refinery.

Ten wildcats have been drilled in different parts of the vast Peruvian Amazon Basin. El Oriente Company, the most active national company, drilled an unsuccessful wildcat in 1947 at Canchahuayo on the crest of the anticline of the Contamana Mountains.

On the Santa Clara dome, about 25 miles northwest of Maquia, two wildcats have been drilled. One drilled by the government in 1947 had to be abandoned at about 1100 ft because of technical difficulties. A second hole was drilled by Ganso Azul in 1956, but abandoned at 3870 ft in the Upper Jurassic Chapiza.

On the Pisqui anticline about 34 miles upstream from the confluence with the Ucayali River, El Oriente Company has drilled two wells. The first was abandoned at 4650 ft just entering the Upper Cretaceous. The second drilled to a total depth of 9106 ft, found some slight oil shows at about 7700 ft in the Agua Caliente sandstone, but struck metamorphized schists on the bottom and was abandoned.

The German syndicate and El Oriente drilled two dry wildcats at Cashiboya and Inuya, southeast of Maquia, to 4579 and 6022 ft.

Texas Petroleum Company has drilled three wildcats on the upper, middle and lower Maranon. The first two reached almost 10,000 ft and the third attained a total depth of 11,537 ft, the deepest well in the Montaña, at a cost exceeding $350,000. But all three were dry holes.

The recent Maquia discovery has revived interest in the vast, little-explored Amazon Basin. Texas Petroleum proposes to drill a new wildcat in the Yurimaguas region, where it has acquired a two-thirds interest in the Yurimaguas concessions of El Oriente. Mobil Oil is activating geophysical surveys in the middle Ucayali area and Cerro de Pasco, which holds extended concessions in the southern Ucayali region east of its mining interests, is continuing active surveys and is reported to start drilling in 1959 or 1960.

Large expenditures for exploration and drilling and much work will still be required for getting a clearer view on the outlook of the Montaña's prospects.

★ ★ ★

From the Basement Complex to the Very Recent...

Petroleum Geology of EASTERN PERU ...Today

Area of Promise

Dr. Werner Ruegg
Consultant and Professor of Geology
Lima, Peru

With over 33 million acres now under concession, a number of significant discoveries, good petroleum prospects, extremely liberal oil law, Peru is friendly and wide-open

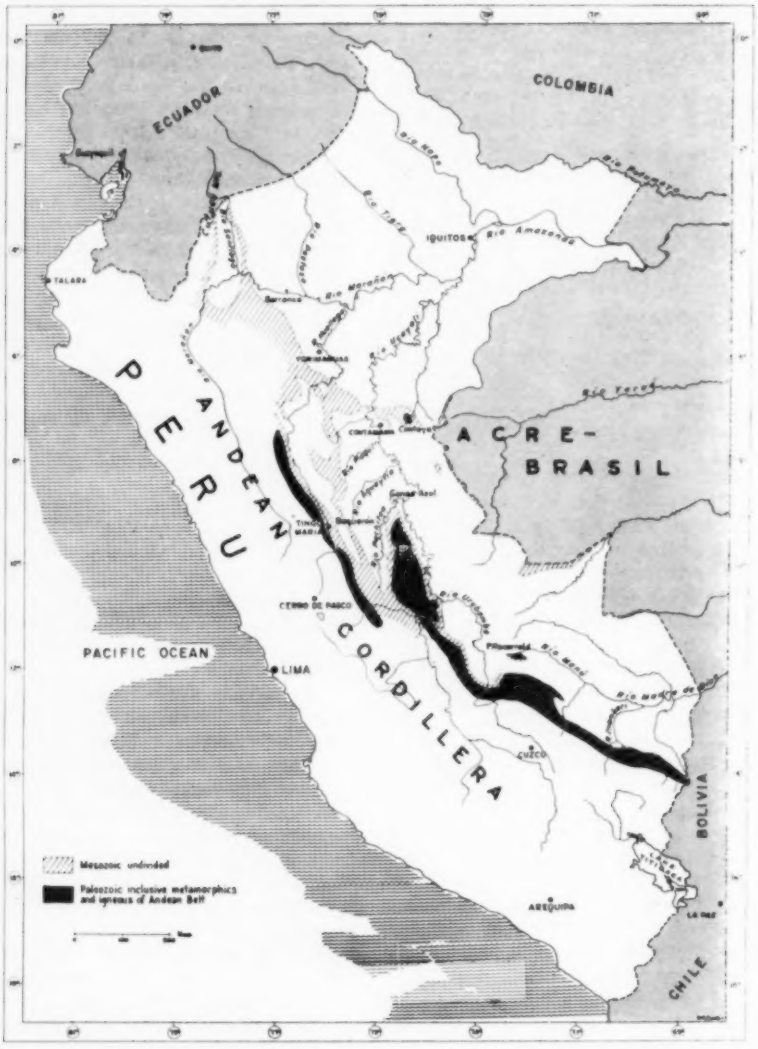

FIG. 1. **Geological map of Eastern Peru** indicating the geologic system of surface rocks. The immense Upper Amazon country is made up of three main units: (1) The high Andean Cordillera on the west; (2) the Brazilian Shield on the east; and (3) the Sub-Andean belt lying between. This region is known as the Peruvian Oriente or the Peruvian Selva.

THE PETROLEUM PROVINCES of Eastern Peru lie within the reaches of the upper Amazon, roughly between 2 and 14 degrees southern latitude. They occupy somewhat less than half of the whole Peruvian territory, totaling far over 212,500 sq miles or about 136 million acres.

This part of the upper Amazon is an immense country which is made up of three main units: (1) The high Andean Cordillera on the west; (2) the Brazilian Shield on the east, and (3) the sub-Andean Belt lying between.

This region is known as the Peruvian Oriente or the Peruvian Selva. There exist two separate basins: The northern or upper Amazon embayment proper, and the southern or Madre de Dios embayment. Each one constitutes rather a topographic basin, bound on the west by the Andean arch and on the east by the Old Crystalline mass, and separated on a north-south line by the Fitzcarrald divide.

A large portion of the vast jungle region is covered by low rolling hills which are deeply dissected. These hilly zones are separated by major swamps and by isolated mountainous ranges which stand out high above the surrounding flood plains. Precipitous mountain fronts provide limits, particularly on the west. Access by river or road is difficult; the few existing roads are sometimes not passable for weeks. On the other hand there is an excellent air service operating to nearly any place in Eastern Peru.

WILDCATS AND OIL

The Peruvian Oriente shelters separately and combined all the desirable features the exploration geologist seeks; namely a thick series of sedimentary rocks, source beds, wedge belts of porosity and all imaginable type of traps, accommodation and sealing properties. It is upon this array of conditions that the selection of the wildcat sites has been based. So far, 11 wildcat locations have been drilled: Well Agua Caliente-1 (Ganso Azul dome), Santa Clara-1 (Santa Clara

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dome), Rayo-1 (Canchahualla anticline, a minor fold of the Contamana uplift), Coninca-1 (Pisqui dome), Cashiboya-1 (Cashiboya anticline a minor fold of the Contamana uplift), Chonta-1 (Chonta anticline near Ganso Azul), Inuya-1 (supposed structure north Cashiboya), Maquía-1 (Maquía anticline), Marañón-8, Marañón-22 and Marañón-110 (stratigraphic tests). These wildcats are shown in Fig. 3.

Ten, out of 11 wildcats, were located either on structurally first class prospects or to obtain exact information as to the thickness of the Tertiary cover and the stratigraphic conditions in general. Inuya-1, however, by no plausible reason whatsoever, was located in the very center of a greater syncline. Apart from the two discovery wells, Agua Caliente-1 in the year 1939 and Maquía-1 early in 1956, all other tests were dry holes. This apparent failure, however, must not be misunderstood since the result is absolutely inconclusive with regard to the far greater part of the extensive area of promise. As a matter of fact, the wells furnished most valuable information and the general knowledge on the stratigraphical and structural design has increased enormously.

Further wildcat drilling is scheduled by the Texas Petroleum Company on a foreland structure closed in Tertiary which lies northeast of Yurimaguas. Texas Petroleum expects to begin this well in the first half of 1958. Also, the "El Oriente" Company in partnership with the Wintershall A.G., Gewerkschaft Elwerath and Deutsche Erdöl A.G., has planned a well on the Pacaya anticline, a secondary warp with Tertiary closure lying between Maquía-1 and Cashiboya-1. El Oriente will move the rig to this new location upon completion of Maquía-6.

Present oil production in Eastern Peru is derived exclusively from the Ganso Azul field where, since 1939, 20 wells have been completed, four of them unsuccessful. The field's production in 1955 amounted to 262,413 bbl, in 1956 to 402,807 bbl and in 1957 to 780,330 bbl. This peak will probably not be surpassed. Oil recovery is continuing normally. Oil reserves have been calculated to amount to 15 million bbl.

Additional production was obtained just recently from the small Maquía structure. The discovery well Maquía-1 struck oil on March 10, 1956, producing 600 bbl per day from the middle and lower sands of the Sugar sandstone at 2136 ft in depth. Maquía-2 and Maquía-3 also came in as producers with 350-400 bbl per day each. Maquía-4 and Maquía-5, however, turned out most modest with 15 bbl per day and water in each. Reason for the unexpected result of these latter wells is not clear. It is believed that a water drive applies to reservoirs in that area, but this fact alone would not suffice to explain the high water cut in the aforementioned wells.

On January 29, 1958, Maquía-6 was spudded in and on February 17 had been terminated at a depth of 2244 ft in the Sugar sandstone awaiting testing. Three wells have been drilled on the axial portion and three wells drilled on the southwestern slope, but the structure has not yet been proved up on its northeastern flank.

It is natural that this find is causing a very marked economic impact on the entire eastern jungle province, and together with the general geologic evidence makes Peru and the petroleum industry look to the future of this vast basin with much founded reasoning and optimism. The long, costly and strenuous experience in the Peruvian Oriente has shown that the fundamental scope of all working in the field is not to concentrate on the Tertiary beds but to get acquainted with the Cretaceous and the suit of older rocks, to thoroughly investigate their structural disposition and to search in the geohistorical past for the relation which exists between the diastrophic movements, the oil migration and its preservation.

Peru has to rank among the leading oil producers of Latin America. It offers a promising oil outlook in extensive areas to be developed, but it offers also good though expensive living conditions, very fair interpretation of the law and an unveiled political sky. Peru is a wide open, friendly, and free country.

CONCESSIONS IN EASTERN PERU

When Peruvian oil production was diminishing rapidly and other areas and reserves had to be investigated and developed, the government launched in 1952 a new, wisely-conceived oil law. National and foreign oil interests were attracted following the promulgation of the new law. This led to considerable exploratory work and has stimulated the expenditure of more capital for drilling than ever before.

Hence, the Peruvian Oriente was soon covered by concessions which as of December 31, 1957, amounted to over 33 million acres. These blocks, owned by 15 national and foreign companies, were mainly focused on the Sub-Andean Belt and represented the largest oil concession area in South America. Some 20 months ago, the total concession holdings, exploration and exploitation together, were about 3 million acres greater. It is evident that the reduction is due to increased knowledge of geological conditions and discouraging results obtained from several wildcats located widely apart; e.g. too thick Tertiary cover, inadequate sequence, unfavorable picture in general, etc.

In spite of the abandonment of a great area and the probability that even more concessions still will be relinquished, there is no doubt that new and extensive concessions will be solicited. This prediction is based on the recent oil discovery east of Contamana, and the striking fact that the immense but remote Madre de Dios embayment is not yet denounced for concessions.

Some companies involved. Among the large concession holders are the major oil companies of the world or their branch-establishments, i.e. Texas Petroleum Company, International Petroleum Company, Richmond Oil Company, Mobil Oil Company, and Gulf Oil Company. Among others are Cia. Peruana de Petróleo "El Oriente" S.A., a very active Peruvian enterprise, Peruvian Pacific Petroleum Company, affiliated with Cities Service and Richfield Oil, and Cerro de Pasco Petroleum Corporation, owned by Cerro de Pasco Copper Corporation which for the first time has entered the oil scene.

STRATIGRAPHY

One stratigraphic section is not applicable to the entire territory of Eastern Peru. Each embayment, according to its situation and position, has its own depositional sequence which differs from another. Exposures are scarce. Also, our knowledge is hampered by the dense vegetation, the size of the basin proper, its local inaccessibility, the restricted number of test wells which are scattered over a tremendous area. Furthermore, the basin is largely covered by alluvium while Tertiary rocks cap the prospective horizons. Solution of many problems, however, can be expected by the different geological campaigns and drilling operations which are in process or at least scheduled.

Basement Rocks

Basement consists of those rocks which form the base or sole of the oldest sedimentary series and which are believed to make up the true basement of the Andean and Sub-Andean system. They consist of metamorphic and igneous rocks which are deep-seated units usually obscured by younger roofing complexes.

The metamorphics are migmatites, phyllites, schists, amphibolites, etc., principally of Lower Paleozoic age or older, in part produced in relation with intrusions of batholitic expanse emplaced during the earliest movement of the Hercynian cycle. The igneous rocks are granitic and syenitic individuals of the alkaline-atlantic tribe, which outcrop in a few places. Most occurrences seemingly are parent rocks of the oldest Paleozoic and Pre-Cambrian Brazilian Shield suit. Aplites, pegmatites, and melanocratic dikes protrude locally.

Basement rocks of that kind have been encountered in the Rayo-1 well at 2496 ft (gray syenodiorite) and in the deepened Ganso Azul well, Agua Caliente-1 at 4117 ft (pink rose granite).

PALEOZOIC

Lower Paleozoic

No sediments of Cambrian age are identified in the Peruvian-Amazonian lands.

Ordovician and Devonian

Ordovician (Gothlandian) and Devonian strata extend throughout the Bolivian Chaco and Caupolicán, the Peruvian Oriente, and trend finally into Ecuadorian territory. In Eastern Peru, these beds are composed of dark shales which are locally abundant in fossils, slates and schists of various kinds, sandstones, quarzites, and conglomerates. These monotonous series, which measure thousands of meters as in the Madre de Dios and Urubamba valleys, begin somewhere in the Lower Ordovician, whose profoundly altered bottom portion may still be older, and continue as far as the Devonian. True Silurian, however, is not satisfactorily recognized in either of the two embayments.

Where the graptolitic and brachiopod facies allowed diagnosis, Chazian fossils were yielded in Contaya and Llanvirnian-Llandeillian or younger were identified in the classic outcrop areas of the Inambari and the Madre de Dios in general. But, for the many good sections studied, there have been as yet no official formation names applied.

The greatest thickness is established along sections in the southeastern jun-

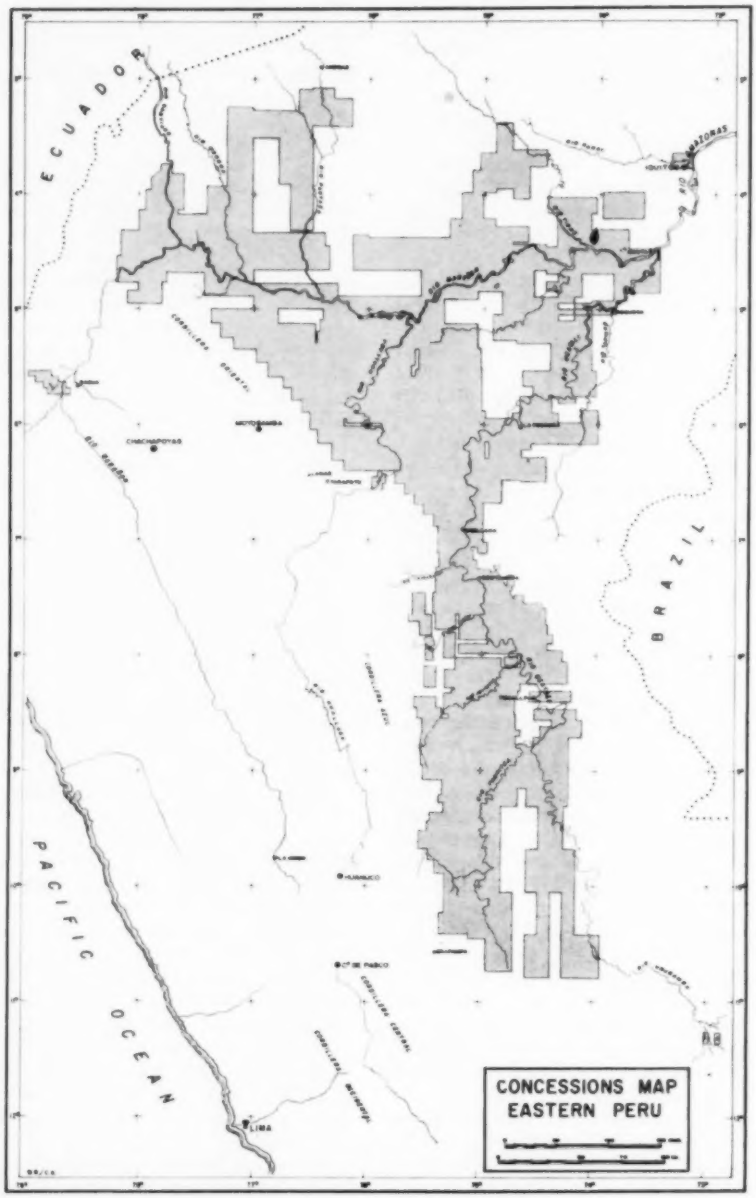


FIG. 2. Oil concession map of Eastern Peru where over 33 million acres are now under concession as indicated by the shaded zones.

gle province. Thinning is observed in a general northern direction, while a stable thickness presumably is again reached in the lower Huallaga and northernmost boundary region.

In Madre de Dios localities, the Ordovician and Lower Devonian contain successions of blackish slightly bituminous shales and slates with rich fauna which most certainly have had a significant bearing on the origin of oil. Other series of principally sandstones and graywackes indicate suitable reservoir rocks. Contrary to the numerous and impressive oil indications in the neighboring region of the Beni, Tuichi, and Madidi rivers of Bolivia, no seepages have been observed in the Peruvian jungle, a fact obviously due to the high extent of structural and magmatic disturbance and the advanced stage of erosion which these series repeatedly have undergone.

Some wells reached the Lower Paleozoic, such as Agua Caliente-1 at 3421 ft, Coninca 1-A at 8889 ft, Cashiboya 1-A at 3346 ft, and Marañón 110-1 at 9624 ft. But, nowhere has the series been tested even partially. The Lower Paleozoic (Ordovician) gave up a showing of non-combustible gas under high pressure in Cashiboya 1-A well.

Upper Paleozoic

A clear gap of regression and denudation separates the Ordovician and/or Lower-Middle Devonian clastics from Upper Paleozoic sediments. The latter beds are transgressive and thus lie either disconformably or angularly on older rocks. This overlap is brought out by the earliest tectonic movement observed in the Andes, the Bretonic or Acadian phase of the Hercynian revolution, dated Upper Devonian-Lower Carboniferous.

Upper Paleozoic rocks have been the object of quite intensive exploration work. Their distribution follows in part the delineation of the older Paleozoic basin, which makes up the backbone of all younger basins. Nevertheless, some old highs might probably have stood out above the encroaching younger Paleozoic seas, while important depositions of other areas have disappeared. The division now in use for these accumulations is as follows from bottom to top:

Lower Carboniferous-Mississippian, Ambo group, continental.

Upper Carboniferous-Pennsylvanian, Tarma group, marine.

Lower Permian (up to Lower Leonardian), Copacabana group, marine.

Upper Permian (comprehensive series through Triassic into Jurassic?) Mitu group, continental.

Mississippian or Ambo Group

Beds identical with those of the Ambo group have not been encountered in either of the two embayments. There are, however, occurrences of thick sandstones, carbonaceous shales and fragmentary plantiferous slates, at intervals interbedded with carbonate rocks devoid of fossils. They appear in the lowermost Permo-Pennsylvanian limestone body and may be looked upon as a transitional semi-continental stage, possibly of Mississippian age. Such sediments are reconnoitered in the Madre de Dios and Manú region in exposures over 1600 ft thick.

Pennsylvanian and Lower Permian or Tarma and Copacabana Groups

The Pennsylvanian or Tarma group likewise is displayed very little in the Peruvian jungle. It is shown plainly that the younger Paleozoic transgression flooded the dry lands very slowly, sometimes only in middle or even late Pennsylvanian time, leaving several elevated sectors unaffected at all. Also, the deposition following the inundation must have lasted in homogeneous sedimentary environments far into the Lower Permian, in such a manner as it is now difficult to distinguish between similar strata of both the Tarma group and the Copacabana group. Indeed, as manifestly confirmed by field geologists, a separation of these two groups is solely feasible by close identification of the microfauna.

The fusulinid facies of the dense bluish-gray Permian Copacabana limestone of principally Wolfcampian age, has its greatest sections (excess of 3300 ft) in the Ganso Azul, Sira Mountains, and Urubamba districts. These carbonates are thinning toward the north and the south.

Upper Permian or Mitu Group

After the departure of the Lower Permian sea and an interval of orogenic movement and erosion, the volcanic Mitu group was laid down. Its depositional area, however, advanced very little into the zone of interest and only a few outcrops have been located in the outskirts of the Andean scarp, i.e., to Chanchamayo, Pozuzo and Tingo María. In these places the Mitu lies unconformably over older rocks, being in its bulk considered Post-Leonardian. These pyroclasts of ash, lava, breccia and all sort of transitional variants, typical Verrucano, represent a remarkable complex in the Andes proper.

Several of the units discussed before exhibit a favorable pattern for oil prospects. For instance, the Copacabana lime, being fossiliferous and locally of the reef forming type as well as extensive and respectably thick, is a possible source formation. Only once have oil shows been spotted in the sequence, e.g., traces of fossil asphalt in the section drilled through in Agua Caliente-1 well. There may be attractive features as far as efficient trapping of oil is concerned in the same Copacabana limestone, which in places may show good primary porosity in lumachelles, clusters of fossils and bioherm growth. Capacity for storage is also revealed in the transitional Mississippian beds confined to the Madre de Dios territory, where at least two seepages have been discovered, one with freely oozing oil and the other with rich saturation.

The following wildcats have drilled into the Upper Paleozoic: Agua Caliente-1 from 1463 to 3421 ft, Permian limestone (then entered directly Lower Paleozoic); Coninca 1-A from 7872 to 8889 ft, Permian limestone (then entered directly Lower Paleozoic); and Maquía-1 at 5146 ft, entered limestone of probable Upper Paleozoic age.

MESOZOIC

Triassic-Jurassic

The early Mesozoic history of that portion of Peru is obscure. Further mountain building and subsequent vulcanism of the Hercynian-Appalachian diastrophism and the apparent prompt wearing down of the Gondwanides are left without records.

Thus, genuine Triassic rocks are not recognized, excepting that in the southeastern jungle area there are peculiar Post-Permian sediments piled up, in part volcanics and detrital-epiclastic materials in Mitu facies, in part psammites and sandy shales. These variegated sequences have accumulated without visible interruption far into the Mesozoic (or even Tertiary?) as do comprehensive series. Without any doubt, they are deposits of terrestrial troughs or shallow, shelf-connected inlets. They grade into the Gondwana or younger beds of northeastern Bolivia.

In the Ucayali-Huallaga basin, the long Permo-Triassic interval might coincide with the precipitation of halite and anhydrite in small, locked embayments concentrated on the western side of the basin. These are the source of the many salt plugs squeezed up during the late Tertiary movements, and which very likely are still active. Their diapiric structures probably not quite in the usual way of salt domes, are located in the Huallaga, upper Pisqui, Aguaytía and upper Pachitea region.

Liassic-Lower Jurassic, Santiago Formation or Lower Boquerón

This is a transgressing formation made up predominantly of carbonates. Two lime units are readily noticeable; a siliceous compact and platy limestone

intercalated with calcareous sandstones and splintery dark shales beneath, and softer limestones, tenuous cephalopod marls and dolomitic tongues above. Interspersed may be cherty nodules, tuffites and intraformational breccias. The Santiago is propagated exclusively in the northern or Upper Amazon embayment, that is, the region covered by the Cutucú Mountains, the Santiago, part of the Marañón, and the Huallaga River. In the middle Huallaga the series reaches at least 1000 ft, but its maximum thickness is over 6500 ft as exposed in the vicinity of Tingo María.

Arietitinae but also brachiopods and pelecypods abound in the marly facies and make the higher portion, at least, Lower Liassic. Older stages may be present also. From a SE-NW line, starting in the Boquerón, the formation vanishes spectacularly toward the east long before getting to the Ucayali.

The Santiago-Lower Boquerón formation is regarded as a prospective rock for the generation of oil. Of particular consideration are the dark gray to blackish limestones, commonly bituminous and with strong hydrocarbon odor, the cream-yellow marls which are often crowded with ammonites, and the black shales. Furthermore, a few sections show locally fair secondary porosity developed by solution, fissuring, faulting, and brecciation. These properties could lead to advantageous reservoir conditions. Good oil indications are seen in the middle Huallaga. There, the Santiago limestone, pressed up and crushed to pieces by perceptibly piercing evaporites, shows high bituminosity and fair oil impregnation.

FIG. 3. Wildcat locations in Eastern Peru indicating producing fields, discovery wells and unsuccessful tests.

Upper Jurassic, Chapiza Formation or Upper Boquerón

Reclining against the escarpment of the high Cordillera and covering only a small elongated strip, this formation is built up of strata which display all the characteristics of redbeds. As such, they do not permit useful and reliable subdivision.

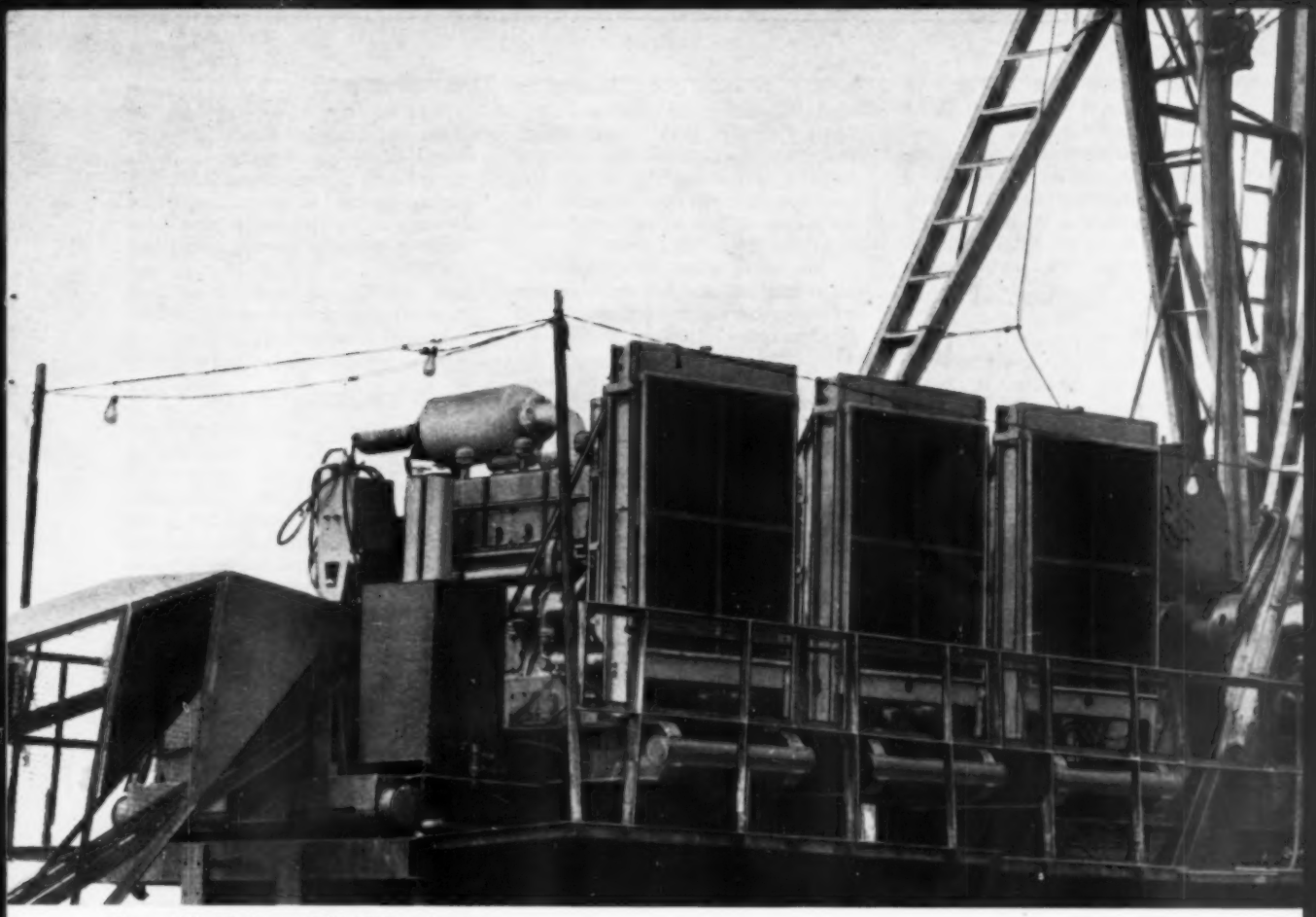
The Chapiza is composed mostly of sandstones and in far lesser proportion of sandy shales, mudstones and conglomerates. Bulk of the formation is cross-bedded and flaggy. Dominant colors are red-brown, brick-red, pink, and violet-purple. Frequently noted in episodic occurrences are pale sandstones, concretionary calcareous ledges, anhydrite and gypsum in the lower third of the series, then conglomeratic sandstone, tuffaceous and even lavic material, by preference in the topmost portion of determinate sectors.

From the upper Huallaga River and Boquerón defile, with thicknesses exposed up to 5900 ft, a gradual dying out occurs in a southern and southeastern direction. Notwithstanding, the series still has been noticed in the Tambo and middle Urubamba River. In the northwestern outcrop area, viz., middle Huallaga, one sequence among others is declared to be over 6500 ft thick. Rapid wedging and tonguing also takes place toward the east and northeast.

The lower boundary of the Chapiza is marked by the unevenly capped Santiago formation, while the upper limit constitutes a truncated surface on which rests with sometimes neat unconformity the Cretaceous Aguas Calientes sandstone. By noting the paucity or total absence of any life on one hand, but the habitat and stratigraphic position on the other, this formation must be attributed a continental origin and a Post-Santiago and Pre-Cretaceous age, i.e., Upper Jurassic.

Since the Chapiza is a formation of unimprovable porosity and first class permeability, it appears to be a most suitable reservoir rock. But, as the overlap on its top coincides rather frequently with an angularity, it must have been preceded by orogeny and erosion periods. Thus, possible pools might have been emptied time ago, though such reasonably established opinions vary between widest limits, especially where geology is in its beginning, as is being proved again and again in the petroleum industry.

The only well which penetrated the Chapiza is Rayo-1 (2250 to 2400 ft) where it was found as a dark reddish sandstone pinchout lying on basement.



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The Santa Clara well 1-A entered Chapiza at 3814 ft for about 56 ft but the bottom was not seen.

Finally, to avoid confusion, the name Sarayaquillo formation should not be used as a substitute for the Chapiza formation, because in the type locality, i.e., in the Sarayaquillo River, such correlative formation does not outcrop at all.

Cretaceous

A considerable time space must be involved between the actual top of the Chapiza and the overlying Cretaceous system. The discordance has been effected by the Kimmeric or Nevadian cycle, but the field information is inconclusive regarding the exact date of this folding event. Where convenient marine conditions prevailed as in the northern Amazon embayment, the Cretaceous developed a nearly complete record of sediments which include three easily distinguishable formations: The Aguas Calientes, Chonta, and Sugar sandstone.

Aguas Calientes Formation

Together with the co-extensive Chonta formation, the Aguas Calientes is the core builder of most of the structures in the Amazon headwaters. It is made up of massive, fine to conglomeratic frequently cross-bedded sandstones which have white, yellow and iron-stained buff colors. Interstratified are gray to black shales, grayish-white siltstones and occasional isolated limestone bands. The facies are distinctly threefold: Fluvial-lacustrine, brackish, and marine. Marine members are evolved in the middle and upper portion of the formation. They represent a shore to neritic facies of ingressions which are not constant in their easterly advances.

The average thickness in sectors of the Pachitea and east of the Ucayali is 1300 to 2300 ft, decreasing to 650 ft and less as in the Utoquinea River. But, in the western Ucayali and Huallaga districts, the thickness is more than twice as much. Deposits in the Cushabatay are known to have in excess of 5500 ft. The stratigraphic relation of these clastics is often angular at the peneplaned base and parallel-continuous on top. Diagnostic-fauna is encountered in the marine Esperanza and Huayo members. A Neocomian age is assigned to the lowermost part, and the highest beds which vary from place to place, range up to the Turonian.

Economic interest is concentrated on the marine black shale deposits, though a reserved attitude toward the value of this possible source rock is recommended. Likewise, there are poor chances of production from primary sands as frequently is suggested. This holds particularly good, keeping in mind the highly oil bearing Lower Aguas Calientes sand of the Ganzo Azul field. The accumulation and productivity of these sands, namely, despite of sealing ash beds occurring beneath, must be interpreted by migration rather than by origin "in situ."

Numerous gas and oil seeps, sulfurous emanations and hot water springs in the Aguas Calientes formation as in the Cretaceous in general, provide the main number of oil indications observed in the upper Amazon. Shows also have been noted in Cretaceous sections in the wells.

Except for the Marañón Wells 8-1 and 22-1, all exploratory wells reached or penetrated the Cretaceous. Some wells started drilling in the Aguas Calientes sands, others in the Chonta, and one well (Cashiboya 1-A) on top of the Sugar sandstone.

Chonta Formation

Widespread in the northern embayment, this formation consists of blue-gray to dark laminated shales (with intercalated yellow-white siltstone) which are poorly or well stratified and frequently grade into calcareous siltstones. Thin to medium bedded limestone outcrops at different levels and in varying amounts. These limestones are gray or, when bleached, are light green and are often crammed with fauna. Sandy shales and shaley sandstones with brown-red shades occur at random. The greatest thickness of 1700 to 3000 ft is found in the Cutucú Mountains, the lower Marañón and middle Huallaga, while in the Boquerón, Ganso Azul, and Contamana region there are sections 400 to 1300 ft thick.

A salient fact is the facies change in a west-east direction, i.e., from marine to brackish and to fresh-water environment. This change is well marked by a notorious shrinkage of the limestone components, but the thickness is balanced by a deliberate development into a type redbed formation. Of practical importance is the fading away of the Chonta toward the southeast and its total absence in the Madre de Dios basin.

The sediments pass upward into the Sugar sandstone with a clearly conformable datum plane. Age of the Chonta depends upon the age of the transgressive basal beds. It may be from Albian to Coniacian, or it is Turonian and Coniacian exclusively. Recent studies made of profuse cephalopod assemblages collected in the lower Marañón area, viz., northwest of Yurimaguas, arrived at a first zoning of the series and proved the presence not only of the Coniacian but of the whole uppermost Cretaceous including the Maestrichtian.

In its best marine development, the Chonta exhibits ideal sedimentary conditions of having transformed prime matters into hydrocarbons. Also, fair original porosity is present, but better porosity and permeability have been acquired by subsequent jointing and tectonic evolution. Thus, in many sections, the Chonta warrants sufficient characteristics of a source rock of petroleum and also permits the prediction of possible accumulation and trapping.

Sugar Sandstone

This sequence comprises a hard, competent scarp and ridge-forming unit of white, gray and cream-brown sandstone. It is massive or cross-bedded, usually of medium grain and sometimes abundantly quartzitic and sugary. Wedging and lensing are also common. There exist intercalations of blackish laminated shales which show micaceous and carbonaneous silty shale partings. Disseminated throughout the series are impersistent gravelly stringers, iron nodules, plant prints, and bone and fossil wood fragments.

The Sugar sandstone is a shore facies and has been set down on the fluctuating edge of the Cretaceous shelf. It occupies a zone from the Cutucú Mountains through the Marañón and Huallaga rivers to the lower Urubamba River and Mainique rapids. The average thickness is 400 to 590 ft, but the isopachs show very considerable thickness variations, i.e., from 100 ft to 1200 ft. As the series is barren of diagnostic flora and fauna, the exact age has not as yet been disclosed. On stratigraphic grounds its age is referred to as Upper Cretaceous.

The complete series of the Sugar sandstone comprises roughly three individual sandstone portions. It has been observed that only the lower sands, or the lower and middle sands are developed locally. The middle portion contains good sealing shale beds.

Good porosity, average permeability, propitious spacing of impervious beds and capping redbeds on top, make the Sugar sandstone an excellent recipient and trap for oil. The productivity of this unit was proved by the important discovery well Maquía-1 on March 10, 1957. An initial production rate of 600 bbl per day was realized from the middle and lower sands of the series at a depth of 2136 ft. The structure is presently being developed.

For reasons of priority and the fact that no such sandstone is outcropping at all in the Vivian Creek, the term Vivian sandstone should be definitely dropped.

Tertiary Redbeds

Following the withdrawal of the

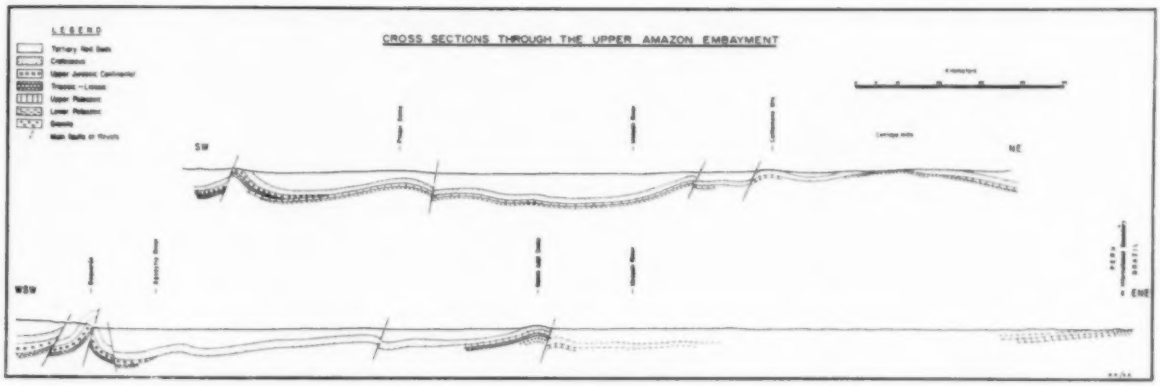

FIG. 4. Three distinct tectonic units are distinguishable in this cross-section of the Upper Amazon Embayment: (1) The Sub-Andean belt; (2) the Ucayali depression, and (3) ridges and plains of the shallow basement.

Cretaceous seas, a new sedimentary cycle began in a principally terrestrial basin throughout the Andean foreland belt. The clastics swept together in this millieu form an ubiquitos sheet over the greatest part of the Peruvian Oriente, masking all other formations and underlying structure.

First, there exists a stage of transitional beds between the Cretaceous Sugar sandstone and the true Tertiary redbeds. This stage or formation is between 300 and 650 ft thick, depending on the locality. It is characterized by thin-bedded to fissile siltstones, clays and marls of gray-brown and predominantly violent tints, which in various places pass upward into well-bedded partly light-gray limestones, as for instance in the Pachitea River, the Boquerón defile, etc. These beds include much fossil algae and mark a typical fresh-water lacustrine deposit. The age, however, is not exactly determined although it looks probable that a lower portion of this formation still belongs to the Cretaceous.

The overlying redbeds are continental sediments throughout. Their main constituents are clay, shale, mudstone, siltstone, sand, sandstone and their multiple transitions. There is a preponderance in the lower half of hard, occasionally sticky clay and shale, usually red or reddish, though green, blue-green, and gray coloring has also been noticed. In contradistinction, the upper half is, as a rule, a more sandy, friable series with excelling yellow, brown-tan, and pale greenish tints. On a grand scale exist differently shaped inter and intra-stratal deposits, such as conglomerates, pyroclasts, impure limestone, heaps and beds of fossils, concretions of lime, clay-stone and limonite, seams of lignite, gypsum and salt, and floods of badly sorted, evidently reworked and redeposited fresh sediment. Local discontinuities are common.

It is self-explanatory that this tumultuous, almost casual accumulation and local mixture, created a redbed formation "par excellence." Therefore, it is not deemed necessary to discuss the many subdivisions and/or members which various students have attempted to establish locally. It has to be stated, however, that the different source material, transport, mode of deposition and environment, moreover the abrupt vertical and lateral lithologic changes and the sparsity of diagnostic organic elements, are collectively adverse factors, which render any subdivision and correlation both in time and space, an extremely risky and difficult task.

An outstanding occurrence is the find in the lower Huallaga and Marañón rivers of a marine to brackish facies, consisting of shales and limestone slabs. This section, 1300 ft thick, is an outlet deposition from the Pacific and, according to its micro and macrofauna, corresponds to the Oligocene. These beds are known as the Pozo formation. Apparently it has been penetrated in the Marañón Well 8-1.

Due more to the different magnitude of erosion and protection in synclinal tracts than to different initial deposition, the thickness of the redbeds is subject to appreciable variations. It is thickest in the middle Huallaga, 13,750 to 21,000 ft, in areas of the upper Ucayali and Urubamba, 11,500 to 20,000 ft, and in some sections in Madre de Dios, 11,500 to 20,000 ft. In the Contamana and Pachitea region the thickness is 9800 ft and less. Greatest thickness in wildcats, about 9000 ft, was logged in one of the Marañón wells.

In late Tertiary times, one of the most important and efficient Andean orogenies started off, the Quechua paroxysm, which is responsible for a profound transformation by uplift, folding, thrusting, imbrication, and salt piercing.

Plio-Pleistocene to Recent

The fairly high Tertiary Molasse Mountains soon underwent peneplanation, and alluvial piedmont fans and other accumulative clastics were spread far into the Brazilian Shield area. These sediments, being judged in the field and from photo-studies, involve levels and episodic events.

Belonging to the youngest geologic epochs is the Iquitos or Pebas formation. It is composed of slightly brackish to fresh-water deposits which are 65 to 260 ft thick. The beds are composed of gray to blackish, highly fossiliferous clays and arenaceous intercalations. Their deposition is from horizontal to sub-horizontal seemingly resulting in an unconformable relation with the redbeds. The origin and age of the formation are debatable. It can be assumed that the fauna is a relict fauna which might have evolved in Plio-Pleistocene time. Series showing similar features are known from many other localities and, therefore, are considered homotaxiale time-equivalents.

In the Aguaytía region, however, the river sediments consist of polymixed strange mesa boulders and gravels which might be taken for an appendix of the flat lying redbeds of that area. Nevertheless, rocks of the Iquitos-Pebas formation or similar beds have never been observed to merge into the actual basin cover; those beds must therefore be older.

Attendant to radial movement, the greater part of the Peruvian Amazonian lands is presently undergoing rejuvenation. This process is authenticated by uplifted river banks, beheaded rivers, shifted valleys, etc. These accumulations sit on a post-orogenic peneplain.

Overlooking the jungle country as a whole, one becomes aware that it includes many early Quaternary and Holocene horizons which have been brought about by multiple and vividly changing conditions. This youngest geologic history, however, is as yet hardly known.

GEOLOGIC STRUCTURES

The petroleum provinces of Eastern Peru reveal a complex geology. Among the main features worth knowing, the structural features are the least known. Hence, the statements pronounced here must be considered as very generalized and strictly tentative.

The Peruvian Oriente basin lies in the Andean foreland and is limited on its western margin by the sharply rising high Cordillera and on its eastern border by the emerging Brazilian Shield. For practical reasons we shall deal nearly exclusively with the northern or upper Amazon embayment. At the end, some information is dedicated to the Madre de Dios embayment.

In the northern basin area, three tectonic units can be distinguished: The Sub-Andean Belt, the Ucayali depression, and the ridges and plains on the shallow basement. The cross-sections in Fig. 4 illustrate this disposition.

Sub-Andean Belt

This belt is bordered on the west by the Andes and to the east grades into the Ucayali trough. It is built up by the foothill structures which culminate in several conspicuous highs. These structures are elongated folds in "en échelon" alignment. They show a NW-SE bearing and frequently are offset by NE-SW trending faults which may adopt an east-west direction.

The individual folds are asymmetric anticlines or domes with steep dips facing east becoming eventually overturned. Thrusting, over-riding and also imbrication upon the foreland occurs. This behavior produced upthrusted and downthrusted flanks as well as squeezing and doubling. Together with longitudinal and cross faulting, the tectonic picture is a block mosaic. A very special architecture is defined by the intrusion of evaporites, giving rise to distracted structures with possible trap conditions along the salt edges. Owing to locally strong faulting, imbrication and salt piercing, certain members and formations have been reduced or cut out entirely. Good seepages, however, are in most cases directly linked up with such dislocations.

The configuration brought about by the frequent occurrence of spurs, hogbacks, cliffs, normal contacts, fault lines, saddles, sinks, plunges, etc., and their correct interpretation by photostudies or directly in the field, always unveil the rough structural pattern of any definite region. Very complex structures require methodical investigation. There are ambiguous structures which only will be unraveled by the drill.

The structural elements of first practical interest in the Sub-Andean Belt are from southeast to northwest: The Ganso Azul domes, the culmination zone of San Alejandro (which is a peculiar junction of curving folds), the Aguaytía anticline, the Pisqui dome, the Cushabatay anticline, the middle Huallaga and Tarapoto domes, and the Yurimaguas anticline. Some of these structures are closed completely in Tertiary or in Cretaceous beds, others are salt domes either capped or open.

Ucayali Depression

The central Ucayali depression is consistently a prominent feature because it constitutes a subsidence conjecturally filled up with potential Tertiary and Quaternary clastics. Little can be said of the nature of its fill and structure. The depression lies in the manifestly unstable zone between the old Brazilian craton and the young Andean chain. Both of these units are of very different composition, position and outline. The Ucayali Valley is therefore balanced according to the movements of the aforementioned units of different mobility. Thus, it establishes a marginal trough probably designing a synclinorium. Seismic work has been carried out just recently in the respective area, i.e., along a line running west-east crossing the Ucayali River near Pucalpa.

Ridges and Plains on the Shallow Basement

This name applies to the area which extends from the east of the Ucayali Valley up to the Brazilian border. The ridges and plains in this tremendous province are developed like a sheet which is settled on the shallow lying basement. A spur of this unit enters only once into the Ucayali depression continuing from there onward with its northwestern trend. This occurs north of Contamana where the river breaks through the plunge of a minor fold of the main Contamana uplift. This cut allows the central Ucayali depression to open in its northern prolongation.

The sheet itself is formed by a series of folds or gentle wrinkles which progress from west to east. The folds are rather slender anticlines and broader domes followed alternately by stretched, flat synclines. The strike is characteristically NW-SE, an alignment which is frequently disturbed by cross-shifting in a general east-west direction. In one way, regarding the symmetry, the structures commonly constitute a counterpart to the ones occurring within the Sub-Andean Belt; because here, east of the Ucayali, the uplifts show short steep-dipping western flanks and large low-dipping eastern slopes. Consequently there exists an obvious tendency evidenced on both sides of the Ucayali Valley, of a bilateral convergence toward the unstable zone of the depression.

Chief among the structures are the Contamana uplift and the Contaya dome. Minor structures are the Cashiboya anticline and its southern continuation. In addition there are the Maquía anticline which lies between the main Contamana fold and the Ucayali River, and some other secondary crumples.

The Contamana uplift is a long, curving, very asymmetrical and rather narrow anticline, segmented by offsets upon which have been imposed several domes. These are closed in the Cretaceous and separated by low saddles. Longitudinal faulting is present, too. The extent and throw of the displacements are fairly well known.

The Contaya dome is a huge, widely dissected, and broad warp. The open Ordovician core is truncated by the Cretaceous and there is clear divergence in strike and dip between the two rock systems. The Contaya area has been affected by two principal cycles of folding. So far, there exists no accurate picture of this tectonic high and its subsidiary structures.

The Maquía anticline, originally termed Cachiyacu anticline, is a secondary, slightly curving fold with distinct plunge to the NW and SSE. It exhibits complete closure in the lower third of the Tertiary redbeds. The eastern flank is thrusted up toward the east. This fact is in flagrant discrepancy with the general westerly directed convergence as displayed by the main Contamana fold. The upthrust defines an asymmetric structure very likely with a short and in part steep easterly slope which can not be observed in the outcropping redbeds. This striking feature is manifestly revived by the big bow made by the Ucayali River and the elbows in all the affluents of the particular region.

Madre de Dios Structures

The Madre de Dios embayment is a twofold tectonic unit separated into a southwestern or southern zone and a northeastern or northern zone. This designation is in harmony with the general strike of the structures which is frequently rather west-east than northwest-southeast.

The southwestern or southern zone is a strongly, locally, even violently folded foot hill zone characterized by imbricate structure. The girdle of folds is to a great part closed in Tertiary redbeds, but partly open in Upper Paleozoics pointing out a most reduced Cretaceous mantle. There is a good number of elongated slender anticlines, but also broader warps with fair to very convenient development. Good, but

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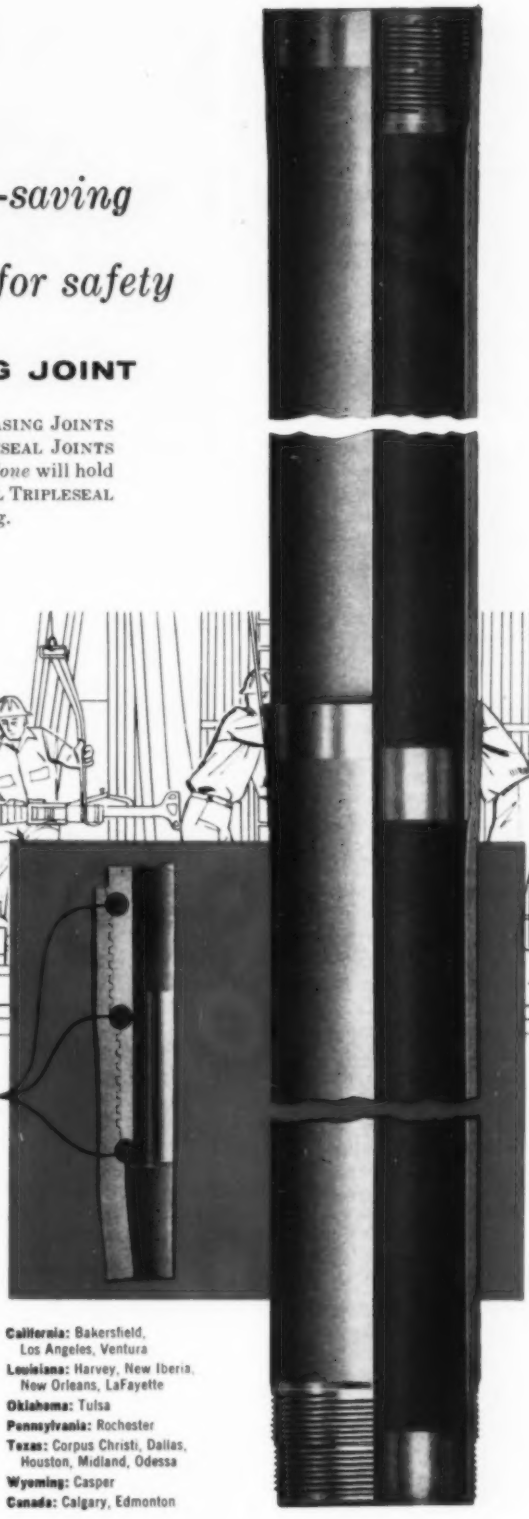

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very scarce, oil indications have been noticed.

Over a considerable distance the northeastern or northern zone commences abruptly, e.g. along a front of upturned scales or fault ledge. Away from this disturbed scarp, the zone continues endlessly into the low land covered with beds which lie completely or nearly flat. These beds are of Tertiary and Quaternary age. They reveal no structure at all though attractive buried configuration may occur. This portion of the country is immense and remote, but does not fail to look promising provided intensive seismic work is scheduled.

Old Basement Chief Structural Control

Field, magnetometer, and seismic investigation have made clear that the chief control on structures has been performed by the old basement pattern. The oldest Paleozoic basin is the embryo of all later basin areas. Likewise, the young folding system is revived on the older structural system which is, in part, co-extensive. Certain forces must have been transmitted through the basement complex and acted probably several times during geologic history on the same lines of weakness. Hence, many faults carry down and a lay-out of mobile blocks has existed since remote times. These blocks are now fairly consolidated though there is still movement as evidenced by epeirogenic oscillation, active salt mobility and small scale seismicity.

Reviewing the work carried out to the present, it is to be ratified that the appraisal of structures is in some way still hypothetical and speculative. However, there are enough structures in Eastern Peru with the necessary encouraging features to store and to preserve oil in commercial quantities. There are many presently unknown structures which, when outlined, may prove to be significant and attractive.

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★ ★ ★

Certificates of Service were presented to four members of the Southern District of API by D. L. Connelly, left, Warren Petroleum Corporation, vice president, API for Production. Recipients were: Jim Bugbee, Shell Oil Company, Houston; M. E. Holmberg, Houston consultant; and T. J. Fuson, Humble Oil & Refining Company, Houston. Louis F. Davis, The Atlantic Refining Company, Tulsa, could not be present to accept his Certificate.

SUCCESSFUL SOUTHERN DISTRICT API MEET

OIL IMPORTS are only part of the industry's economic problem today, said John B. Hussey, Louisiana Conservation Commissioner at the three-day Southern District API meet held in Houston recently. Other factors are: (1) Seasonal ebb in the oil market; (2) tight money policy, (3) vast expansion of gas industry which replaced fuel oil, and (4) unrestricted production of increasing quantities of gas distillate. Navy Captain Matthew V. Carson, speaking on "An Exploration of the Problems Involved in Petroleum Import Limitation" reported on the status of the voluntary import plan . . . not including products . . . saying that it has met with reasonable success. Various methods for limiting imports, he said, are: (1) Point of origin . . . or by countries from which the oil originates, (2) import tariff, and (3) setting a relationship between imports and refinery throughput.

Roy A. Bobo, Phillips Petroleum Company, Houston, was elected as the new chairman for the Southern District API to succeed Ben F. Carter, Union Producing Company, Shreveport, Louisiana.

Over a thousand oil men from five states attended the three-day meet which included a full day of committee meetings, and two days of technical papers concerned primarily with drilling and production problems along the Gulf Coast.

Certificates of service. Four Certificates of Service were awarded by D. L. Connelly, API vice president for Production, to M. E. Holmberg, Houston consultant, T. J. Fuson, Humble Oil & Refining Company, Houston, Louis F. Davis, The Atlantic Refining Company, Tulsa, and J. M. Bugbee, Shell Oil Company, Houston.

New Southern District Officers

Roy A. Bobo, Phillips Petroleum Company, Houston, was named district chairman to succeed Ben F. Carter of Shreveport.

Vice-chairmen named were Walter Kalteyer, chairman for Southwest Texas; Earl Thomas, Southwest Louisiana; Charles D. Schutz, Balcones area; C. J. Russell, Ark-La-Tex area; Isaac Ault, Southern Louisiana; W. W. Wilson, Rio Grande Valley; Joel Battle, Texas Gulf Coast; Sam Cox, East Texas; W. L. Massey, South Central Texas, and J. B. Flemming was elected district secretary-treasurer. Ben F. Carter becomes chairman of the district advisory committee.

This is one of the most important articles on drilling to come along in years! — The Editors.

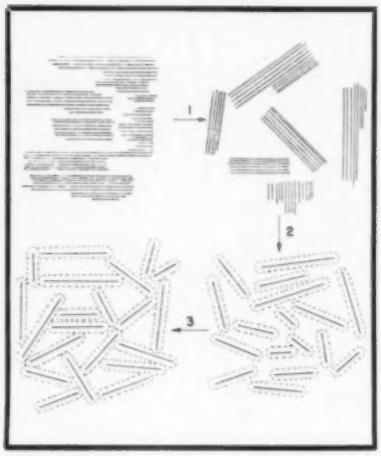

FIG. 1. **Shales disperse** in mud in the steps shown above: Grinding action breaks compacted material (1) into chips or cuttings; water attacks cuttings (2) of which certain types disperse into microscopically fine clay particles; and thus the shale becomes finely incorporated into the mud, severely affecting viscosity.

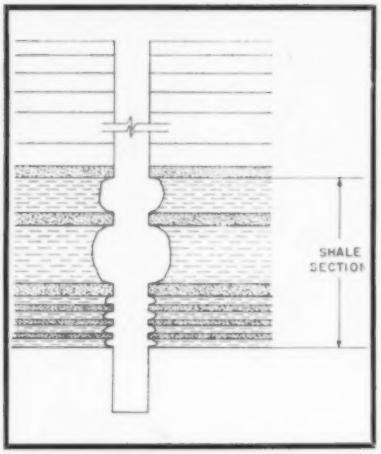

FIG. 2. **Heaving shale condition** is very often not at all like most drillers imagine it. Actually, the shale responsible for the trouble may be washed from the hole as an integral part of the mud, leaving hard and less susceptible sections unsupported as shown.

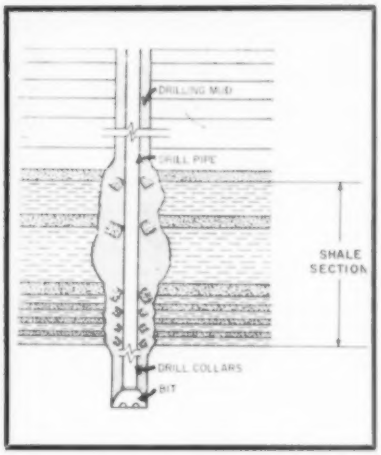

FIG. 3. **Shale heaves?** The unsupported sections then fall into the hole — they often cause the pipe to stick. The typical observation of hole fill-up during round trips is often symptomatic of the penetrations of so-called "heaving shale."

P 425.218.435

A Fundamental Approach to

WELL BORE STABILIZATION

by W. J. Weiss, R. H. Graves, and W. L. Hall

The Texas Company, Research and Technical Department, Exploration and Production Research Division, Bellaire, Texas

AS DRILLING has proceeded to greater depths, the penetration of certain massive shale sections has become one of the major drilling problems, particularly along the Gulf Coast. These troublesome shale sections have both limited well depth and greatly increased drilling costs.

This deep drilling problem has two main facets:
(1) drilling equipment and techniques, and
(2) drilling fluids.

The outstanding developments in equipment and operating techniques are outside the realm of this presentation which will limit itself to the development of a new approach to the drilling fluid problem as developed by The Texas Company.* In the past, researchers in drilling fluids have devoted their efforts mainly to improving the physical and fluid properties of the muds themselves. As drilling has progressed deeper, however, it has become a prime function of such drilling fluids to maintain longer and longer sections of unprotected, open formations in a stable condition. *When these open sections become unstable and the well bore collapses, the well is said to have "heaved," and such formations known to collapse readily are given the name "heaving shale" by operating personnel.*

In many areas deep drilling, using currently available mud systems, has been possible only through strict adherence to the maintenance of "perfect" mud properties while in other areas the limit of drilling had apparently been reached, because even with liberal expenditure of time and money in applying all known techniques, further penetration was practically impossible.

In an analysis of this problem, it became apparent that an attack had to be made from a more fundamental basis with the aim of developing a new type of drilling mud system specifically designed to meet the conditions encountered in deep drilling. As mentioned earlier, the primary function of such a new fluid must be well bore stabilization. An intimate knowledge of the properties of the unstable shales and

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INCREASES PRODUCTION by eliminating tubing breathing and buckling, thus lengthening the effective pump stroke and raising volumetric efficiency. While it is often difficult to determine exactly how great such increases are, many operators have told us that they have experienced as much as 50% gain.

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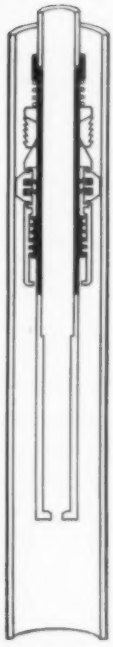
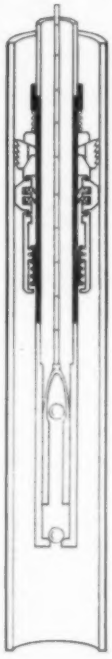
A

Tubing run-in, Anchor not engaged



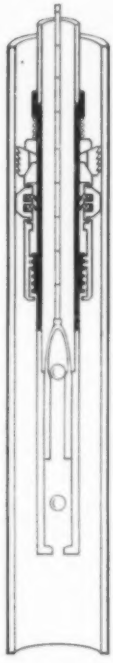
B

Pump in place. Anchor engaged. Tubing stretches with down-stroke of pump. Anchor is moved downward.



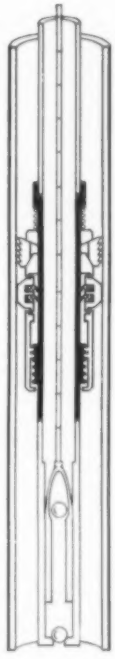
C

Up-stroke does NOT move Anchor or tubing. Succeeding down-strokes move Anchor downward until . . .



D

Maximum elongation due to increasing fluid load has occurred. Tubing is in proper tension to eliminate both breathing and buckling



WHAT DOES COMPENSATING MEAN?

HOW DOES IT WORK?

"COMPENSATING" means that the tubing is allowed to adjust itself to compensate for any changing well condition that requires additional tension in the producing string. The above illustrations show how the Anchor is adjusted downward by one factor (in this case the increasing fluid load in the tubing) causing tubing elongation. Any other factor (temperature rise, annulus decline, etc.) requiring an increase in tubing tension, is automatically compensated for in a similar manner.

In order for a tubing anchor to accomplish complete elimination of both breathing and buckling, it is necessary for it to be so designed and constructed that it will continually catch and maintain the tubing at the lowermost point in its downward travel during each adjustment. Only in this manner can the exact amount of tension required be kept in the tubing string at all times . . . and only Baker Compensating Anchors have this feature, as illustrated in the drawings below.

Fig. E

Slips of Anchor engaged in I.D. of casing, maintaining tension in tubing.

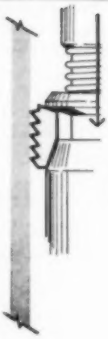


Fig. F

As tubing elongates, Slips momentarily disengage sufficiently to allow tubing to move downward.

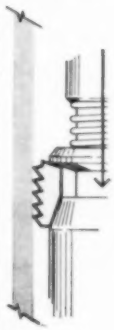


Fig. G

Anchor being moved down casing by tubing elongation. Note that Follow-Up Spring maintains contact between Cone and Slips, keeping Slips against casing so that . . .

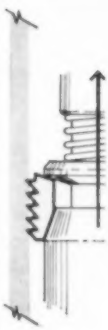


Fig. H

When tubing tries to reverse its direction and move upward, Slips are **immediately re-engaged,** maintaining proper tension—eliminating gauging, hammering.

of the clay minerals composing them is essential for the development of such a mud, and basic research in clay chemistry must provide this necessary background.

In Fig. 1, we see a representation of what occurs when a shale disperses. Upon drilling, the grinding action first breaks the compacted material shown in the upper left hand corner into large chips or cuttings. As water attacks these cuttings, certain types swell and disperse into millions of microscopically fine fundamental clay particles which are intimately incorporated into the mud so as to severely increase viscosity. These particles may further regroup themselves as shown in the lower left so as to gel the mud to such an extent that it can no longer be used as a drilling fluid without major correction.

After chemical treatment has reached saturation, the only course left is to dilute these solids with water to a reasonable concentration. Normally, such dilution must be accompanied by the addition of large quantities of ground barite to maintain the mud density required to restrain the formation fluid pressures present in the well.

To prevent the excessive buildup of solids in the mud system, the sequence shown in Fig. 1 must be broken at stage 2 so as to prevent dispersion of the macro shale cuttings, which can be easily removed from the mud by screen, into the microscopically fine particles which cannot be so removed.

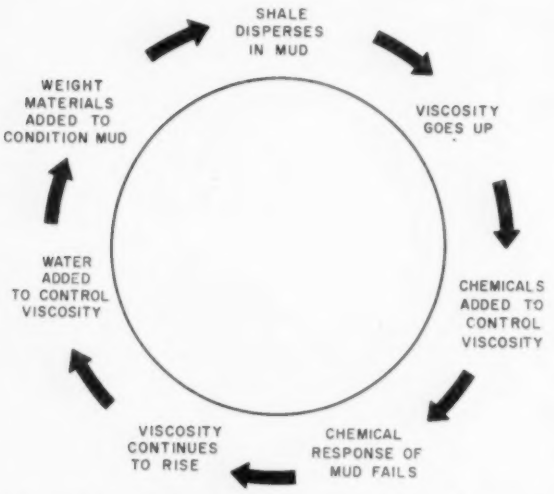

SHALE DISPERSES IN MUD
VISCOSITY GOES UP
CHEMICALS ADDED TO CONTROL VISCOSITY
CHEMICAL RESPONSE OF MUD FAILS
VISCOSITY CONTINUES TO RISE
WATER ADDED TO CONTROL VISCOSITY
WEIGHT MATERIALS ADDED TO CONDITION MUD

FIG. 4. **Vicious circle of mud chemistry** on many rigs drilling massive shales.

The problem of well bore stabilization arises from the fact that certain critical shales exhibit spontaneous self-dispersion. Fig. 2 shows the effect upon the well bore of this self-dispersion of shale. When undermining has reached a critical extent, the unsupported brittle shales and sands will collapse. This accounts for the widespread field observation that "heaving shales" are hard, brittle shales. From Fig. 2, it is apparent that the "heave" is a result and not a cause and that the heaved material, although responsible for sticking the drilling tools, is not the primary problem.

It is obvious that "heaving" is also a structural problem for in highly dipping formations the allowable extent of undermining is severely reduced. It is impossible at this time to identify this type of shale by any of the current logging techniques, but its fundamental difference is readily apparent in a simple experiment wherein undried fragments of the two types of shale are dropped into ordinary tap water. The normal shale will be unaffected while a critical shale will be dispersed into mud even without agitation.

Any successful attack on the problems of well bore stability and excessive solids buildup must deal primarily with preventing self-dispersion of the shales exposed in the well bore.

In order to ascertain the primary factors responsible for the abnormal reaction of these self-dispersing shales, a large number of clays and shales were analyzed.

These studies were conducted to relate the type of shale disintegration to well bore instability, and established two distinct mechanisms in shale disintegration, namely; (1) a physical change in shape and volume arising from swelling due to the imbibition of water, and (2) a spontaneous disintegration without a change in volume which we have given the designation "self-dispersion."

In line with these developments, it was noted that:

(1) Most of the commercial drilling mud bentonites, although exhibiting a high degree of swelling are not normally of the self-dispersing type and require supplementary mechanical agitation for dispersion.

(2) Samples of severe "heaving" shales cored in Gulf Coast wells underwent spontaneous self-dispersion without appreciable swelling.

WHAT THIS ARTICLE IS ABOUT

In the past drilling fluid research has dealt with simple improvement of the fluid's properties. This study deals with stabilization of the well bore as the result of its contact with a shale controlling mud composition.

Research into the causes of well bore collapse, heaving shales, and methods to combat them has led to the development of a mud system which is effective in controlling sensitive shales while being relatively inexpensive to compound, simple to control, and safe to use.

The shale control mud system is shown not only to preserve, but progressively to solidify such sensitive shales in a manner previously only possible by use of the silicate mud system, and to differ radically from presently used shale drilling fluids such as the high pH limed muds, salty muds, gypsum base muds, and other surfactant muds.

The mud has been used to date in over 150 Texas Company wells and selected well data are presented to show that well bore stabilization by use of this system has appreciably reduced mud costs and drilling problems associated with such shale bodies.

The use of this system has enabled penetration of shale sections previously considered impossible while using older techniques.

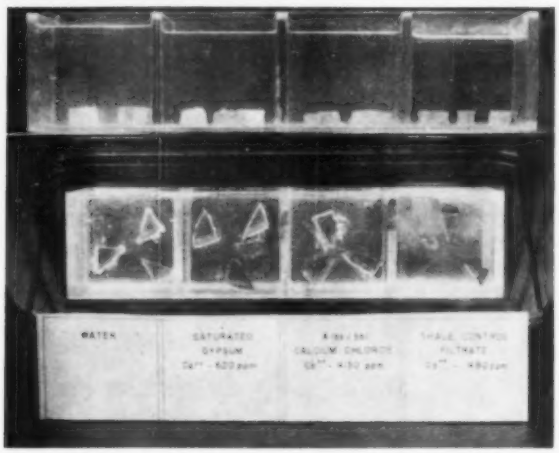


FIG. 5. **0-Hours** for the shale samples in water at the left. The remainder of the samples have been immersed for 14 days. The two in the center containers are in electrolytes — the one at right in TSCM (Texaco Shale Control Mud) filtrate.

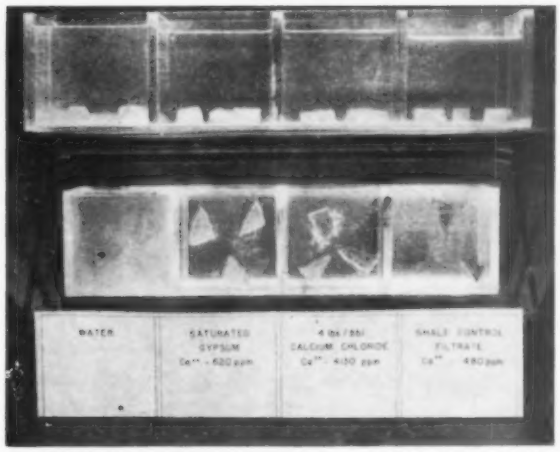


FIG. 6. **1-Hour** for the water sample. It is already starting to disperse. The samples in the solutions of electrolytes in the center containers show some cracking because of dewatering by osmosis.

Shale Stabilization

The problem of "heaving shale" stabilization has received some sporadic consideration over a period of years, but such studies have usually considered the problem to be highly selective and applications limited to a very few specific localities. A more detailed evaluation of drilling problems has shown well bore stabilization to be not only a widespread Gulf Coast problem, but prevalent as well in many other areas of the United States and Canada.

One of the first fundamental attacks on the "heaving shale" problem was conducted by The Texas Company and culminated in the silicate mud development.[1, 2, 3] The use of nonaqueous (oil base) muds has been proposed, although to the writers' knowledge, they have not been used in the field specifically for such a problem. Unsuccessful attempts have been made using brine muds containing sodium chloride or calcium chloride.[4]

The approach followed by the present investigation was to develop a liquid environment which would convert the self-dispersing type shales into those possessing the characteristics of normal shales.

A major problem in such a study is to obtain reference shale material. These materials must be preserved in their original moist condition because after drying, most shales will disintegrate by exfoliation when rewet.

Reference samples were contacted with solutions of many compositions and although the high pH limed mud system is the most highly developed and widely practiced shale control procedure in use in the Gulf Coast area,[5, 6] it was found that self-dispersing shales will soften and lose physical strength in contact with filtrates from such muds. Therefore, the high pH limed mud system is not primarily a shale stabilizing medium and any shale effects observed arise only as a result of the concentration of electrolyte present in the filtrate phase of the mud and not as a result of reaction with such electrolytes.

Another striking result of these studies was that many electrolyte solutions such as caustic soda, salt, calcium chloride, saturated gypsum, and high pH limed mud filtrates suppress disintegration by self-dispersion at about the same level of electrolyte content, i.e., 2-4 lb per API bbl. However, the self-dispersing type shales in contact with these solutions imbibe liquid and develop a degree of soft incompetence which makes them very sensitive to mechanical disintegration. Thus, these systems are not adequate since the turbulent agitation in a well bore is such that, under drilling conditions, materials of this character will still be unstable.

These results substantiated field observations and explain why earlier attempts with salty muds, extremely high alkalinity red and red limed muds, gyp muds and even older attempts with calcium chloride brine muds have proved discouraging.

The sodium silicate mud filtrates on the other hand will progressively solidify incompetent shales and impart a mechanical as well as a chemical stability to such troublesome shale sections.

Further studies on the chemistry involved in reactions with clay containing materials led to the present shale control mud system which, by coupling a high filtrate calcium level with a controlled alkalinity environment, develops a progressive solidification type of shale stabilization, which is similar to that previously obtainable only by use of the silicate muds.

Samples of dispersing shale placed in contact with a high pH, high calcium mud filtrate undergo a progressive solidification which, within reasonable time, renders them as hard and flinty in character as chips of highly compacted normal shale. This solidification is of quite permanent nature since samples so solidified have been found to remain fresh water insensitive even after exposure for several months.

The series of photographs in Fig. 5 through 8 show the spontaneous dispersion of specimens of such a self-dispersing shale material after 0, 1, 3, and 16 hours contact with water as compared with similar material in contact with selected test solutions. The specimens in the solution sections represent the end result of 14 days aging in these solutions. The specimens in the low electrolyte strength solutions; namely, the saturated gypsum and shale control filtrate are undistorted. Those in the stronger calcium chloride solution have undergone some osmotic dewatering with resultant cracking. It is to be noted that the complete dispersion in water was accomplished without any mechanical agitation and devoid of the physical distortion previously deemed necessary and commonly referred to as "bentonitic-type swelling."

Fig. 9 shows the striking shale solidifying power of the shale control filtrate. The simple calcium solutions although inhibiting self-dispersion have left the specimens mechanically weak so that they were readily disintegrated by the 110 gram platform. On the other hand, the shale control filtrate had solidified those specimens so that the platform and an additional 1000 gram weight could be supported easily using merely the tips of the specimens.

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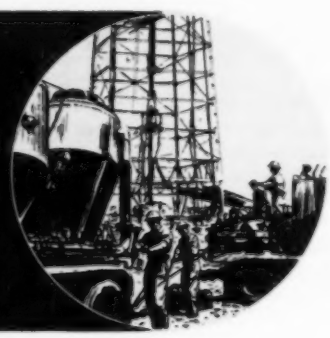

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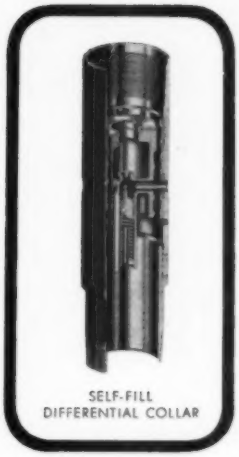

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DIFFERENTIAL COLLAR

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Designed expressly for use with Halliburton Super Seal Floating Equipment, the Self-Fill Differential Collar is engineered to fill casing automatically, with greater speed and safety as it is run into your well. Only one fill-up collar is required for each casing string, regardless of depth.

Placed above the uppermost Super Seal Float Valve, the Self-Fill Differential Collar offers these important advantages:

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- Helps to eliminate dangerous low pressure areas which often promote blowouts.
- Unlike most other fill-up devices . . . downward flow of fluid is not restricted when casing is raised.
- Better control over blowout dangers . . . low differential pressure between annulus and inside of casing maintained by the spring-loaded valve.
- Plugging reduced . . . casing is filled from side-ports above end of casing where mud is cleaner.
- Circulation may be established downhole without tripping valves.
- Faster, easier flushing of cuttings and settlings from float valves on each pickup of casing string.

SUPER SEAL
FLOAT COLLAR

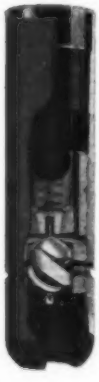
SUPER SEAL
FLOAT SHOE

HALLIBURTON'S SUPER SEAL FLOATING EQUIPMENT

The Float Shoe and Float Collar equipped with the positive acting Super Seal Valve gives extra protection while running, landing, and cementing casing in a well. Provides more than twice the sealing area of usual ball and seat valves for positive shut-off against back pressure below. Special concrete formula gives superior shock resistance and guiding efficiency.

HALLIBURTON'S CEMENT GUIDE SHOE

The landing of the first joints of casing on bottom to be cemented may be hazardous. Safety is increased by installing a Cement Guide Shoe on the first joint. The strong, durable, rounded Guide directs the casing away from ledges to reduce side-wall caving, safely passes through crooked holes, and penetrates temporary bridges.



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FLOAT SHOE

HALLIBURTON'S TURBO-JET FLOAT SHOE

Engineered to float and guide casing strings to bottom, this tool also helps to agitate and distribute cement outside the casing to minimize channeling. Built-in rotor forces powerful jet-stream of fluid through side ports and bottom to agitate cement for more uniform cementing around casing. All parts are drillable.

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GUIDE
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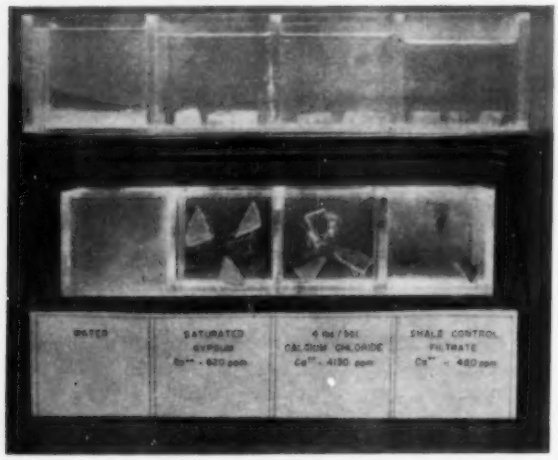

FIG. 7. **3-Hours** for the shale in water; most of the shale has been dispersed in the water. Note the sharp outline of the samples in the shale control filtrate at the right.

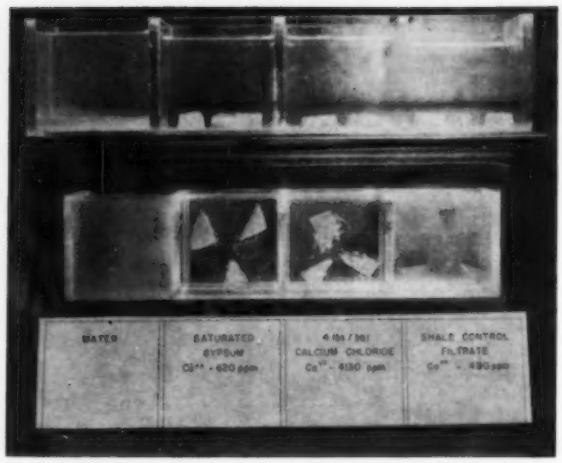

FIG. 8. **16-Hours** for the water sample, and only a shadow of the shale samples are reflected in the mirror that shows the bottom of the containers. The other samples have changed but little.

Shale Control Mud

The prime requirements for shale stabilization which must be maintained in the shale control mud are: (1) Controlled filtrate alkalinity, and (2) a high calcium ion concentration in the filtrate. Proper physical properties of a fluid of this type for use as a drilling medium depend upon several other factors, but the above constitutes the basic chemical criteria.

For field operation, a typical fluid of this type may be compounded entirely of calcium — containing materials by the use of calcium chloride, slaked lime, a satisfactory stabilizer, and a suitable filtration controlling agent. This mud can be used with or without oil as desired without the need for additional emulsifier.

To assist in the formulation and maintenance of the propperly balanced shale control chemistry, "shale control reagents" are available from various mud additive manufacturers for this purpose.

Since this fluid is basically a flocculated and restabilized mud, its native filtration properties are poor, and being a non-dispersing system for clays, the addition of clay or bentonite will not succeed in correcting these poor filtration properties. Therefore, a prehydrolyzed type of starch, carboxymethylcellulose, or similar calcium insensitive agent is normally required for filtration control.

Following conversion, a typical unweighted mud of this type will possess the properties shown below:

TABLE 1. Mud Properties of Typical Unweighted Shale Control Mud.

Wt	10.0 lb per gal
Visc	38-50 sec
Gel Values	Stormer
Initial	0 gm
10 minute	5-40 gm
Shearometer Values	
Initial	less than 0°
10 minute	less than 8
API Water Loss	8 cc/30 min
Cake Thickness	2/32 in.
pH	12±
Pm	8-10 cc N/50 H_2SO_4
Pf	0.5-1.0 cc N/50 H_2SO_4
Calcium Ion	400-800 ppm

In addition to a peculiarity in the filtration performance to be discussed later, the mud is further characterized by an unusual gel and viscosity structure.

It has been found that the funnel viscosity pattern is similar to that often noted in emulsion muds wherein a mud appearing highly fluid in the mud ditch exhibits funnel viscosities higher than anticipated. Funnel viscosities of 100 sec are not unusual and the mud has performed successfully with funnel viscosities running in the 130-150 sec range. Such abnormal viscosities are not considered desirable in field use for they could be indicative of a dislocation in the shale control chemistry of the system.

FIG. 9. **Dramatic proof of the effectiveness of TSCM!** Pistons loaded with 110 gram weights were set on top of the inner portions of the samples. Of course the shale in water had already dispersed — the piston simply rests on bottom of the container. But notice the mechanical failures of the samples in electrolyte solutions (two in center). The mechanical properties of the samples of shale in the TSCM filtrate were so enhanced by the 14 days, 16 hours in the solution, that they supported not only the 110 grams, but an additional 1000 grams!

This mud seldom exhibits the 0-0 gel considered so important in the high pH limed mud system. In fact, such a gel is not only unnecessary, but is undesirable. The initial gel should be a definite 0, but a 10-minute gel of 10 to 40 grams stormer (0^{30} to 8.0 shearometer) is considered a

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Depth of operation was approximately 3200'. Seven inch OD 20 lb. casing had been set on top of the pay. Production was from 6⅛" open hole with a gas/oil ratio of 1800 cubic feet per barrel.

McCullough's Radiation Well Logger with Scintillation Detector was run to determine the depth and detail of the oil sand. Simultaneous Gamma Ray and Neutron Curves were recorded. Gas/oil contact was established from the Neutron Curve. Following this a McCullough Caliper Log obtained excellent detail of the open hole.

From this information a production packer was set and the well was put back on production. Gas/oil ratio decreased from 1800 to 200 cubic feet per barrel.

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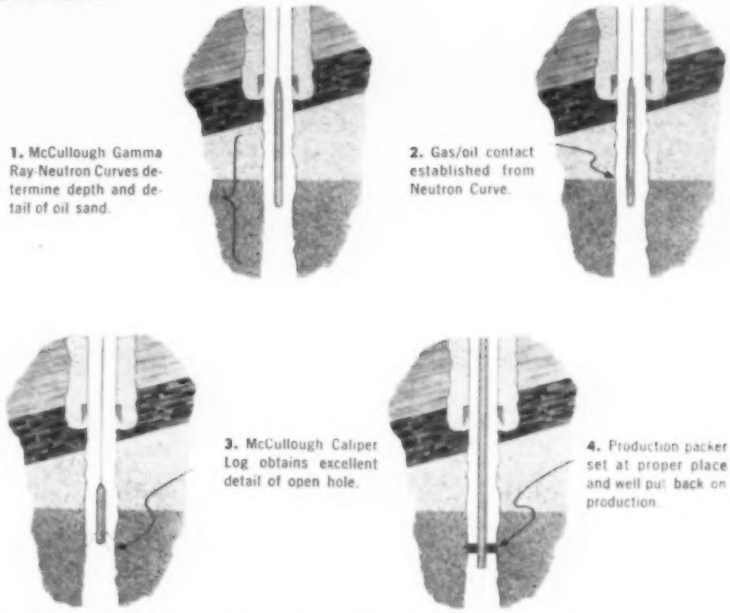
PROBLEM: Gas/oil ratio too high—1800 cubic feet of gas per barrel of oil.

SOLUTION:



1. McCullough Gamma Ray-Neutron Curves determine depth and detail of oil sand.
2. Gas/oil contact established from Neutron Curve.
3. McCullough Caliper Log obtains excellent detail of open hole.
4. Production packer set at proper place and well put back on production.

RESULT: Gas/oil ratio reduced from 1800 to 200 cubic feet of gas per barrel of oil.

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good operating range. This mud possesses a very low initial gel strength which increases slowly with time, but only to a low limiting value. It is for this reason that such finite 10-minute gels do not prove troublesome.

In filtration control, the shale control system represents a radical departure from present systems, wherein shale disintegration is a time function and is dependent in part upon the rate of wetting of the shales. With the high pH limed mud systems, shale stabilization has been subject to two main lines of attack: (1) Reducing the rate of filtrate invasion by lowering the filtrate lost to the formation as much as possible, and (2) increasing the mud density to hold back the caving shales. Since the shale control mud attacks the problem of shale stabilization at the source and contains a filtrate that is not only nonsoftening, but actually a consolidating influence, filtration control is keyed only to the prevention of "tight hole" or "mud ringing" opposite permeable zones.

In field applications of the shale control mud, it has been demonstrated that, were it not for the well bore stabilization problem, filtration control of drilling muds would not be nearly as critical as has been presumed.

Four wells have been drilled to 16,000 ft or more with muds weighing 14-16 lb per gal and having API filter losses of between 7 and 8 cc per 30 minutes. One well was converted from a high pH lime base system where an API waterloss of less than 1.5 cc and a mud density of 15.8 lb per gal had failed to stabilize the well bore and finally resulted in lost circulation when additional weighting and conditioning were attempted. The shale control mud with a 7-8 cc water loss was then carried with a maximum mud weight of 14.5 lb per gal to total depth which was approximately 1200 ft below the original point of failure. This additional 1200 ft consisted of a substantially solid shale body, which had proved impossible to penetrate with the limed mud system.

A second advantage which arises from the shale preserving action of the shale control mud is that these muds exhibit appreciable restricted mud making properties upon drilling shales. This arises from two causes (1) the cuttings are not subjected to a dispersing environment and, therefore, a higher percentage of shale is discarded over the shaker screen, and (2) those cuttings which are mechanically ground too fine to be discarded by the screens resist deterioration and dispersion into the viscosity creating colloidal sizes.

Field Evaluative Procedures

In an approach to evaluating shale control and well bore stabilization on a field basis, we were faced with a problem which will arise in attempting to evaluate any preventive measure, for as it was effectively summed up by many, *"if the shale runs and we get stuck or the hole closes up, we hit* **heaving shale,** *but if we get through all right, the heaving shale body isn't there."* Therefore, to fully evaluate the shale control mud, it was necessary to establish the presence of a serious shale problem as well as prove its correction.

The field evaluation of shale control encompassed several approaches:

(1) Observations on the quantity and character of shale cuttings recovered on the shaker screen while drilling structurally comparable wells in known troublesome shale areas.

(2) Evaluation of the mud making characteristics of various mud systems. This was evaluated by comparing the calculated theoretical amount of weight material necessary to prepare the total volume of weighted mud present in the mud system, during various periods or over the entire shale drilling interval, against the actual weight material added to the system.

In known troublesome shale areas, dispersing mud systems were commonly found to require 2 to 3 times the theoretical amount of weight material to maintain a given weighted mud system and values in excess of a six-fold requirement have been noted.

(3) Water meters were installed on numerous test wells to determine the amount of water added to the mud system while drilling various shale sections. Water consumption was often ⅓ or less of that normally required with other mud systems.

(4) A positive type proof was obtained in a number of wells in which high pH limed muds had been used until well bore instability had reached a state where further progress was impossible. It was found in these cases that, after conversion of the mud to the shale control system, the well bore could be cleaned out to a new stable geometry and drilling continued without further trouble.

Field Application—CASE HISTORIES

South Liberty Field

In the South Liberty field of the Texas Gulf Coast, little difficulty had been experienced with well bore stability through the shale sections, but the mud costs were high (because it was necessary to drill through a highly dispersible shale section). The large volumes of mud accumulated while drilling the shales made it necessary to continuously discard mud while replacing the weight material and chemicals lost in the discarded mud. Drilling in this field thus appeared to be one of the applications for which the shale control mud had been designed.

Four wells were drilled under direct laboratory supervision and field control procedures substantiated. Three additional wells were then drilled with little or no help from the laboratory proving the applicability of the mud under normal field conditions.

In all seven wells, the volume of mud made from the formations drilled was drastically reduced, and was reflected in sizable reductions in mud costs. Field personnel were pleased with the ease and straightforward chemical type maintenance of the shale control mud and with the increased safety resulting from the elimination of the high con-

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TABLE 2. Performance Characteristics of Various Mud Systems in South Liberty Field, Liberty County, Texas.

Well	Total Depth	Type of Mud	Weight Material Consumption		Final Mud Weight	Mud Costs	Shale Drilled
			Theoretical	Actual			
3	9,500 ft	Limed red emulsion 12.9 lb/gal. Reclaimed base mud	872 sacks	2568 sacks	12.5 lb/gal	$36,650	2800 ft
1-4	9,957	TSCM-E (R) 11.0 lb/gal. Reclaimed base mud	3319	3126	13.1	12,500	3487
4	10,708	Low pH phosphate emulsion to 10,001 ft	2053	5030	11.8		
		Limed red emulsion	2071	4124	13.5	23,000	4254
5	10,202	Phosphate mud to 9527 ft	1754	3018	11.9		
		Limed red mud	—196	507	11.6	14,749	3552
7	9,051	Limed red mud	3104	4964	13.4	17,990	2958
1-3	8,300	TSCM-E	2060	2164	12.1	8,405	1991
3A	8,610	TSCM-E (R)	1150	990			
	ST 6000-8200	TSCM-E	450	469		11,279	4280
13	10,200	TSCM-E	1831	1705	12.2	11,385	3520
14	10,200	TSCM-E (R)	1485	1540	12.1	7,980	3490

TSCM — Texaco Shale Control Mud.
(R) — Mud Converted from Reclaimed Mud Weighing 10.5-11.0 lb per gal.
E — Emulsion
ST — Sidetrack

centrations of caustic soda normally used in the conventional high pH limed mud systems. Because of the clearly demonstrated advantages in cost and ease of application, the use of the shale control mud has been generally adopted as standard procedure for all wells drilled by The Texas Company in the South Liberty field.

The primary economic advantage of the shale control mud in the drilling of massive dispersing shale bodies arises from its saving in barites consumption. Table 2 shows the results of shale stabilization on the barites consumption and the resultant effect on mud costs. It will be noted that the other mud systems used two to three times the amount of weight material theoretically necessary to compound a mud system of the final mud weight and volume. With the shale control system, the weight material consumption approximated the theoretical amount.

Because of the extent and severity of shale problems on the Louisiana Gulf Coast, the shale control mud was applied in several representative fields in South Louisiana. This gave an opportunity to test the applicability of the mud to different areas, and various other ramifications of the shale problems.

East Hackberry Field (Louisiana Gulf Coast)

In the East Hackberry field of Louisiana, the problem was very similar to that encountered at South Liberty. Some hole trouble had been experienced, but mainly mud costs were high because of the extreme mud-making tendencies of the shale sections drilled. The problem at East Hackberry was more severe than that encountered in the Liberty area because of the greater depth and extent of the shale sections.

The East Hackberry well was drilled successfully with the shale control mud at a saving of about 25 percent in mud costs over any previous well in the field.

The shale control mud was also applied to more extreme Louisiana cases where the shales encountered were not only bad mud-makers, but gave rise to extreme hole instability which had limited penetration depths.

Overall Results on Gulf Coast

A review of shale control mud performance in 67 wells in 32 areas along the Texas and Louisiana coasts clearly demonstrated the ability of this mud to combat hole difficulties, thus allowing greater depths of penetration in many areas, as well as greatly decreasing mud costs in most areas of troublesome shale. These advantages may be reflected in either a decrease in mud cost for a given well, or a greater depth of penetration for the same total mud cost.

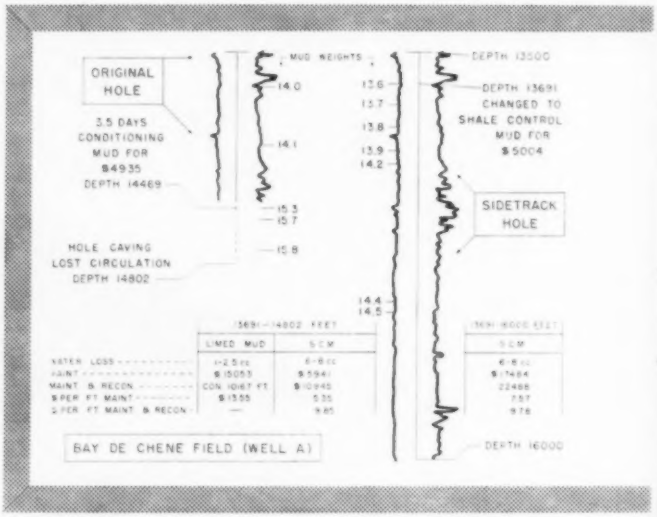

FIG. 10. **TSCM solves a problem** in the Bay de Chene Field in South Louisiana. Despite 3½ days spent in conditioning mud in the original hole, lost circulation and hole caving made drilling ahead impossible below 14,802. Bottom of the hole was cemented, and after side-tracking the mud converted to shale control mud. Drilling proceeded with virtually no trouble with water loss varying from 6 to 8 cc and lighter mud weights.

The effectiveness of the shale control mud in stabilizing shale and in reducing mud costs is best shown by some specific examples.

Bay de Chene Field

In the drilling of Well A in the Bay de Chene field, the mud system was originally converted to a conventional limed mud system. As drilling proceeded deeper, increasing difficulty was experienced in keeping the hole open. On the left side of Fig. 10 is reproduced the electric log of the hole below 13,500 ft. Following generally accepted field practice, the water loss had been carried at low values in an attempt to limit the rate of liquid attack on the shale, and the mud weight had been raised as the drilling proceeded in an attempt to physically restrain the caving shale. At a depth of 14,469 ft, it was necessary to spend 3½ days raising the weight and lowering the water loss at a cost of $4,935 before drilling could proceed. The hole continued to give trouble and further increases in weight were neces-

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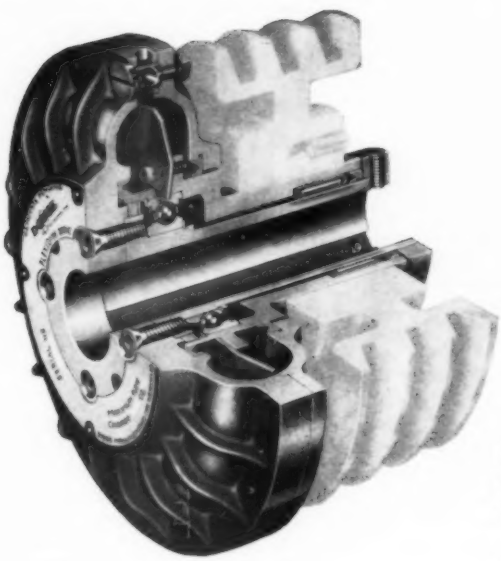

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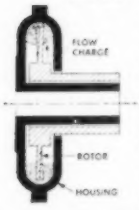

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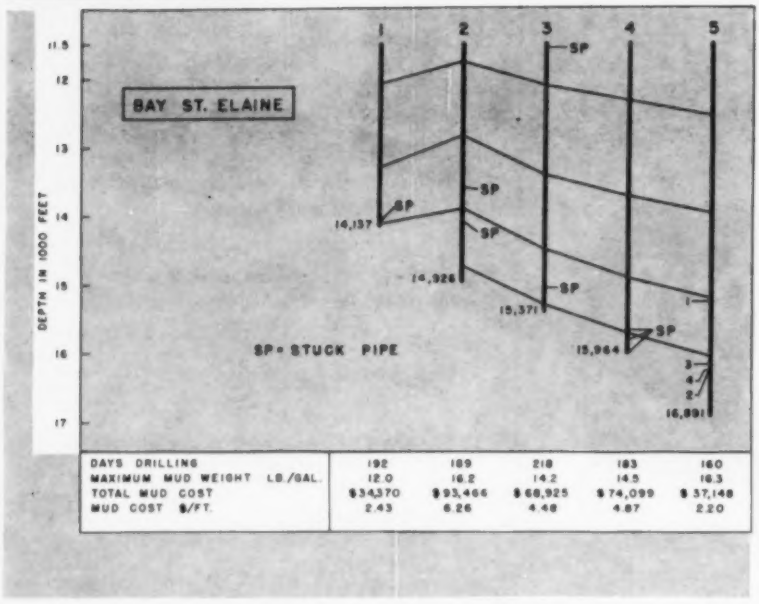

FIG. 11. **By eliminating "SP" (stuck pipe) and lowering mud costs, TSCM** paid off in Bay St. Elaine Field! Using conventional muds, drillers stuck pipe a total of 8 times in four wells, the deepest of which was 15,964 ft. Using TSCM — Well No. 5 above — a well was drilled in the same field to a depth of 16,891 ft in 23 fewer days than Well No. 4 and the savings in cost of mud is obvious.

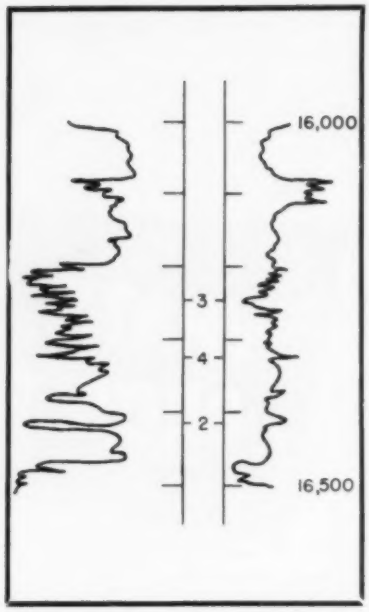

FIG. 12. **What is "heaving shale?"** Wells 2, 3 and 4 stuck in "heaving shale" — Well No. 5 was drilled through it with no trouble. This is a detailed electric log of the troublesome section.

sary until the well reached 14,802 ft where in combatting additional sloughing the high mud weight caused formation rupture and the mud was lost. It was then necessary to pull back up the hole and cement in order to regain mud circulation.

Upon drilling the cement, the drill bit was deflected into the formation so that a new side-tracked hole was drilled. As penetration beyond the previously reached depth would have been impossible with the high pH limed mud system, the mud was converted to the shale control mud system.

Conversion was carried out at a depth of 13,691 ft and drilling proceeded using this mud at weights only sufficient to restrain formation fluid pressures. As fluid from the shale control mud stabilizes rather than deteriorates shale, a relatively high water loss was allowed.

No further hole difficulties were experienced and a total depth of 16,000 ft was reached. A comparison of the two electric logs in Fig. 10 shows that identical sections were drilled with the two muds.

The maintenance cost of the shale control mud was only slightly more than one-third that of the conventional low fluid-loss limed red mud for the same interval drilled and even including the reconversion was only two-thirds of that spent in maintaining the high pH limed mud. The mud costs for the total hole drilled with the shale control mud, including the additional 1200 ft of massive shale do not show the tendency to increase rapidly with depth which has been experienced with the other conventional mud systems. It should be pointed out that these figures also do not show the savings in other drilling costs effected by the elimination of hole trouble, for a liner had been scheduled for 14,800 ft should that depth be again reached, yet no protective casing was required to total depth. Another difference in the comparison is that in the light of a previous history of lost circulation the shale control mud hole was drilled practically to total depth without benefit of shaker screens as the mud was heavily protected with lost circulation fiber.

This example is only one of a number of experiences in the field application where high pH limed muds had reached the limit of penetration and conversion to the shale control system allowed additional drilling. Because of the incompatibility of the two systems such reconversions represent needless expense and are not recommended as a general practice. Current practice is to go directly to the shale control systems where shale problems are anticipated.

Bay St. Elaine Field

Another example is a series of wells in the Bay St. Elaine field. Fig. 11 shows geological correlation from the electric logs of five wells in one sector, and illustrates that these five wells penetrated the same geological sections. The first well, No. 1, was drilled in 1948 and the improvements in drilling techniques in recent years which allowed deeper penetration are graphically shown in the figure. However, the incidence of stuck pipe and the fact that the "geological depths" of No. 2, 3, and 4 are practically identical suggest that the drilling limit had been reached. The "geological depths" as compared to Well No. 5 are shown on the left side of the figure. The first four wells were drilled with conventional limed mud systems and the last, No. 5, with the shale control mud.

The substantiation of the original premise that "heaving shale" need not be shale at all is shown in Fig. 12 by the detailed electric log of the section where well bore instability on Wells 2, 3 and 4, caused repeated loss of hole and stuck drill pipe. The formation is apparently a shaly sand which upon wetting with a dispersing filtrate disintegrates into a variable quicksand condition.

The development of this mud is an improvement in drilling technique which not only reduces hole troubles, allows deeper penetration and cuts drilling time, but also drastically reduces mud costs. Fig. 11 illustrates the reduction of hole troubles by the absence in No. 5 of the pipe sticking experienced in the other four wells and prevalent in this field. The deepest previous well in this field, although not in this block, was drilled by the same rig and crew through similar sections with conventional high pH limed mud just prior to

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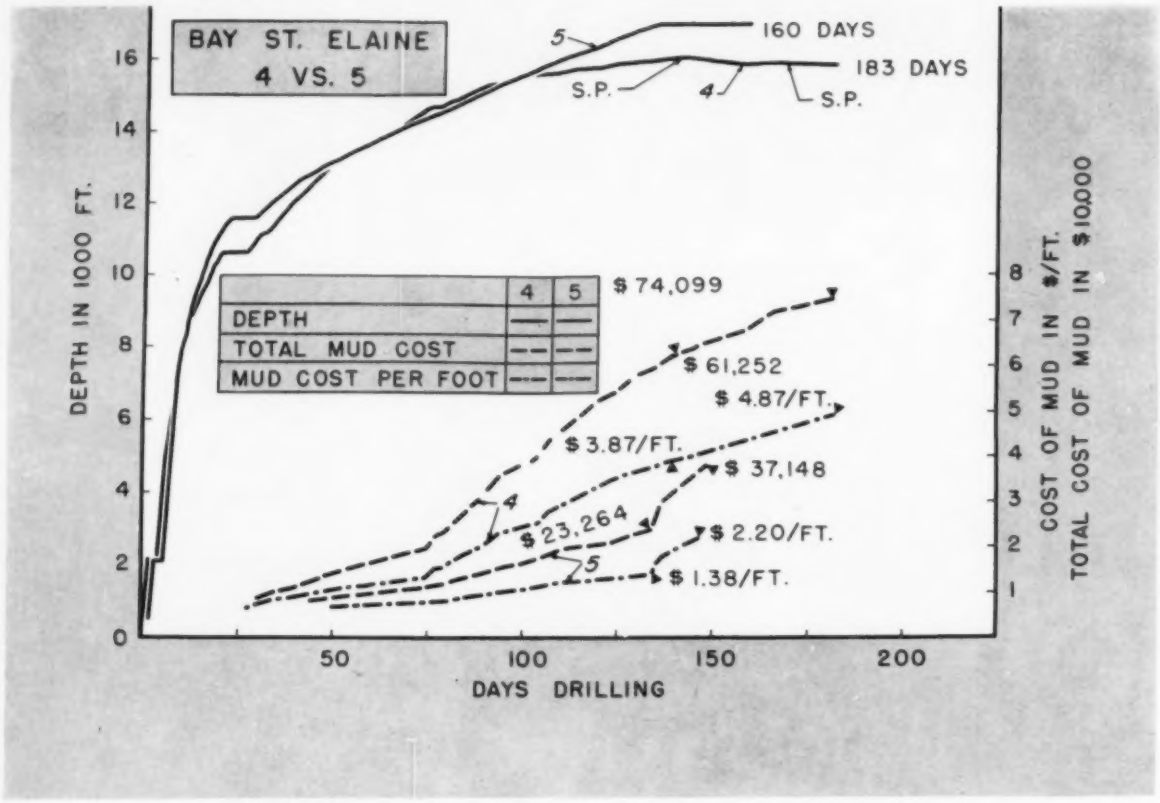

FIG. 13. **Mud costs and progress compared in similar wells in same field.** (See FIG. 11.) When TSCM was used, the mud costs were halved, although the well was drilled almost 1000 ft deeper than the similar well.

Well No. 5 and reached 16,300 ft after a mud expenditure of $108,000. This compares to the depth of 16,891 ft reached in No. 5 at a mud cost of $37,000.

Fig. 13 presents a more detailed comparison of Wells No. 4 and 5. The drilling curves indicate that penetration rates at medium depths are comparable for this new mud and conventional muds. As the depth increases, the drilling rate with the shale control mud continues fairly constant while that with the conventional mud drops off sharply. This is, of course, a reflection of the amount of hole trouble being encountered.

The two sets of cost curves show that the shale control mud was much more economical in those portions of the hole in which no hole troubles were encountered and eliminated the sharp cost increases accompanying any hole trouble. It should be pointed out in comparing these cost figures that the 10 percent rise in cost of mud materials between the drilling of No. 4 and 5 was not taken into account. Again the savings in other drilling costs effected by decreasing hole difficulties and greatly reducing drilling time are not included. The sharp cost increase at the end of drilling of Well No. 5 was the result of a change in the well program.

Operating Experiences

As with all new drilling tools, experience must be gained to utilize the full advantage offered by such tools. From an economic standpoint, conversion costs for the shale control mud have been found to be about the same as those of the high pH limed mud system with maintenance costs averaging about 60 percent of those of the limed red mud system. In some applications with low weight mud and where little or no shale problem existed, the cost of the two systems was about equivalent. In others, cost differentials were even greater, and in some cases, represented the difference between success and failure.

The drilling characteristics of this mud are also somewhat different than those of the limed muds. By maintaining a stable well bore, there is a minimum of time lost in tripping the drill string, and the necessity to repeatedly ream and condition hole except for mechanical reasons is substantially eliminated. Therefore, the overall drilling time is often reduced and in certain cases has been sufficient to be reflected in the number of bits used to drill a given section.

On the other hand, since the cuttings will not readily disperse as in other systems, drilling techniques must be

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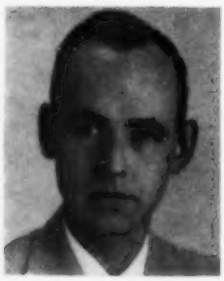
A registered engineer in California, he is a member of AIME and the API Southern District Study Committee on Drilling Fluids.



Wilbur L. Hall

Wilbur L. Hall *received his BS degree in Mechanical Engineering from the California Institute of Technology. After returning from the service he graduated with a BS in chemistry from the same institution in 1948. Since that time he has been employed as a chemist in The Texas Company's Exploration and Production Research Division Laboratories, first in Long Beach, California and currently at Bellaire, Texas. He has been associated with practically all phases of the control and chemistry of drilling fluids.*

watched because a bit balled due to "crowding," will be more difficult to clean in this system.

Another outgrowth of this efficient shale suppressing mechanism is that in some sections the troublesome shale is of such a quantity and so effectively suppressed that the wells fail to make sufficient mud volume and supplementary reserve mud must be added to maintain volume.

Another important drilling practice is to avoid applying water to the shaker screens. Since the mud is designed to surround the shale cuttings with a protective environment, it is obvious that spreading them out on the shaker screen and flooding them with fresh water is poor practice. Since the shale control mud has a very low initial gel and the shale cuttings do not soften and become excessively sticky, no difficulty has been encountered in operating the shaker screens dry.

Any water is added to dilute the mud as a whole preferably in the shaker screen box near the discharge of the flow pipe to obtain maximum turbulence and rapid mixing.

The well bore stabilizing influence of this mud has proved advantageous in sidewall coring so that large undisintegrated specimens of the self-dispersing type shales have been recovered. In "dirty sand" zones where the associated clays are of the self-dispersing types and past core recoveries have been consistently poor, core recoveries using the shale control mud have proved superior.

The tolerance to salt of the physical properties of the shale control mud has been shown to be equivalent or superior to the high pH limed mud system. The mud is a low alkalinity mud, but in being a flocculated type, is not as sensitive to additional flocculating agents as are the conventional low alkalinity muds. Here again field experience has substantiated the permanence of the shale solidification in that during salt-water flows, the wetting of previously drilled sensitive shales by raw salt water has not caused their collapse.

Mud Formulation

The mud can be formulated and maintained using the various individual components by adhering to the chemical criteria. However, since shale control is based upon maintaining a certain chemical environment in the filtrate phase of the mud, it has been found that the mud lends itself admirably to the preparation of a premixture of chemical agents in such ratios that the required chemical balance in the mud can be readily obtained and stabilized without the problems associated with watching the several individual relationships necessary to maintain proper performance of the mud.

It has further been determined that by use of chemicals in their proper relationship, the overall economics of the system may be enhanced, since vacillations in the chemistry, often arising with use of the individual components, can lead to unnecessary chemical consumption.

Conclusions

In summary, it is concluded that field experiences with the shale control mud have fully substantiated the basic researches which led to its development.

That the mud is fundamentally different and an improved mud system has been dramatically shown in a number of wells in which conditions had developed during use of the limed mud system to such a point that drilling progress had ceased. The muds were converted to the shale control system, the well bores cleaned out, restabilized, and successful drilling resumed. Three of these wells, one of which has been previously discussed, continued on to total depth for additional penetrations of 1198 ft, 875 ft, and 1437 ft, respectively.

Acknowledgment

We wish to express our thanks to the operating and engineering groups who assisted in the field application phases of the shale control mud development, and to the management of The Texas Company for granting permission to release this for publication.

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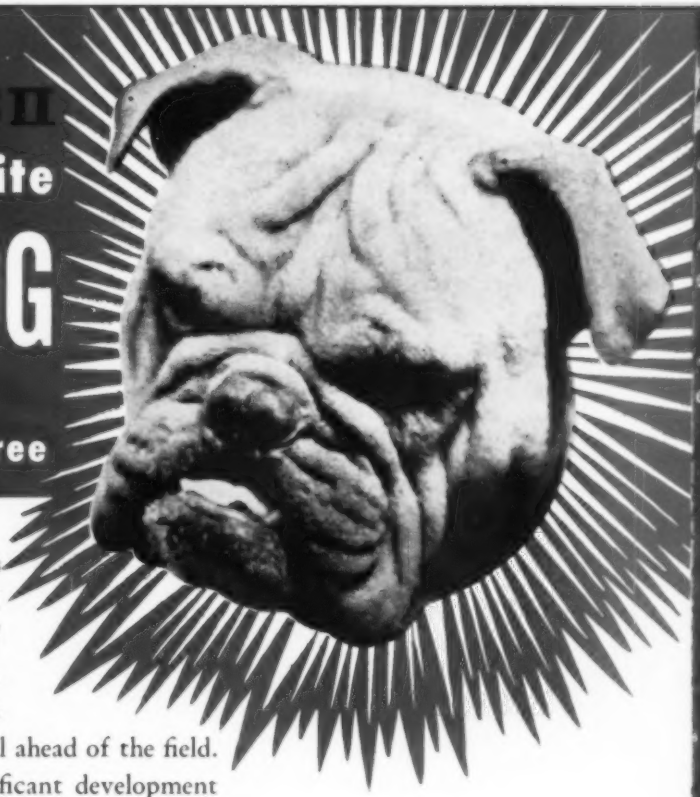

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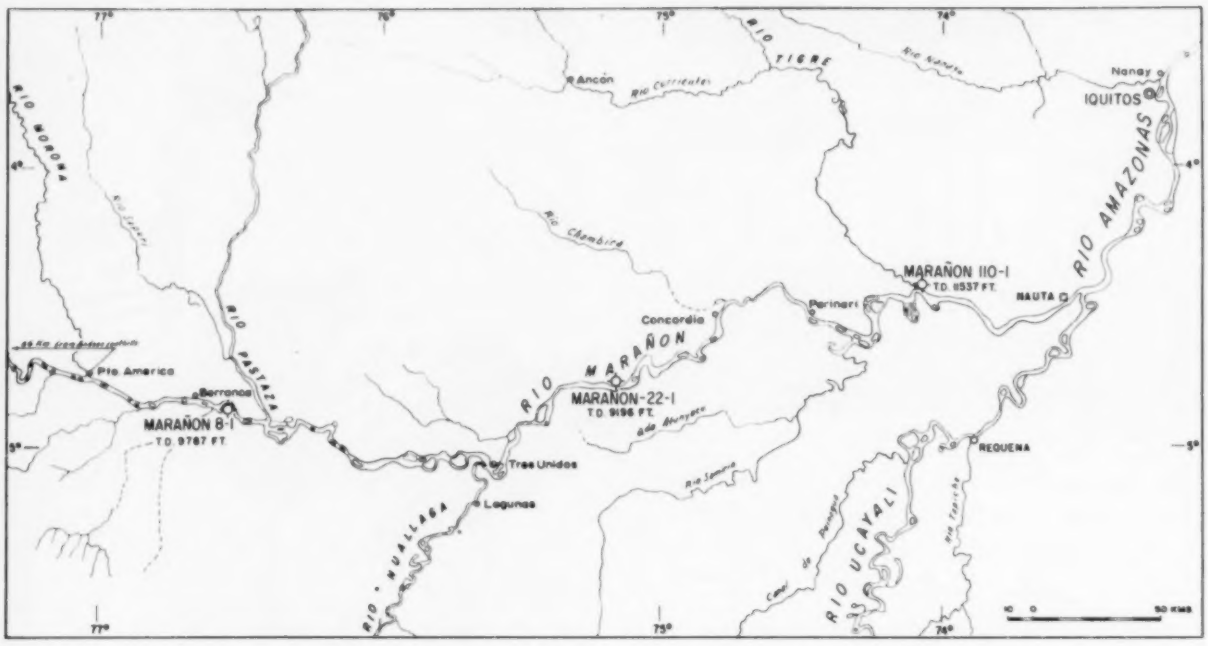

FIG. 1. **Marañon Valley** was the site of three deep wildcat sites — drilled with a light, highly mobile rig. Rio Marañon was the "road."

Drilling in Marañon Basin of Peru

A flooding river, dense jungle, long supply lines and hard formations make exploratory drilling a challenge

Andrew H. Allbee and Samuel T. Pees
Texas Petroleum Company, Lima, Peru

UNDER THE FAVORABLE 1952 Peruvian oil law, the Texas Petroleum Company acquired concessions amounting to 4,939,991 acres in Eastern Peru. Since that time, the company has been actively engaged in exploration activities within these blocks. After surface reconnaissance and seismic work, a light drilling rig was moved in to drill three stratigraphic test holes along the Marañon River. The design of the rig recognized the problems of size, weight and mobility which were necessary to consider in the transportation of the equipment over water and for drilling in the rain soaked, thick jungle areas characteristic of the Peruvian Oriente.

Topography and Hydrography

The terrain along the Marañon east of Puerto America is of very low relief and the region is topographically a part of the vast upper Amazon Basin plain. During the rainy season, the lowlands become swampy except for the higher alluvial terraces. Also periodic flooding has created many permanent marshes, lakes, and abandoned meanders. The only relief is caused by intermittent levees along the present day bank, abandoned levees marking ancestral courses and Plio-Pleistocene terraces. The latter have the highest elevation and thus are usually the sites of riverside villages. The ancestral levees are often a little higher than the present system due to a minor sub-

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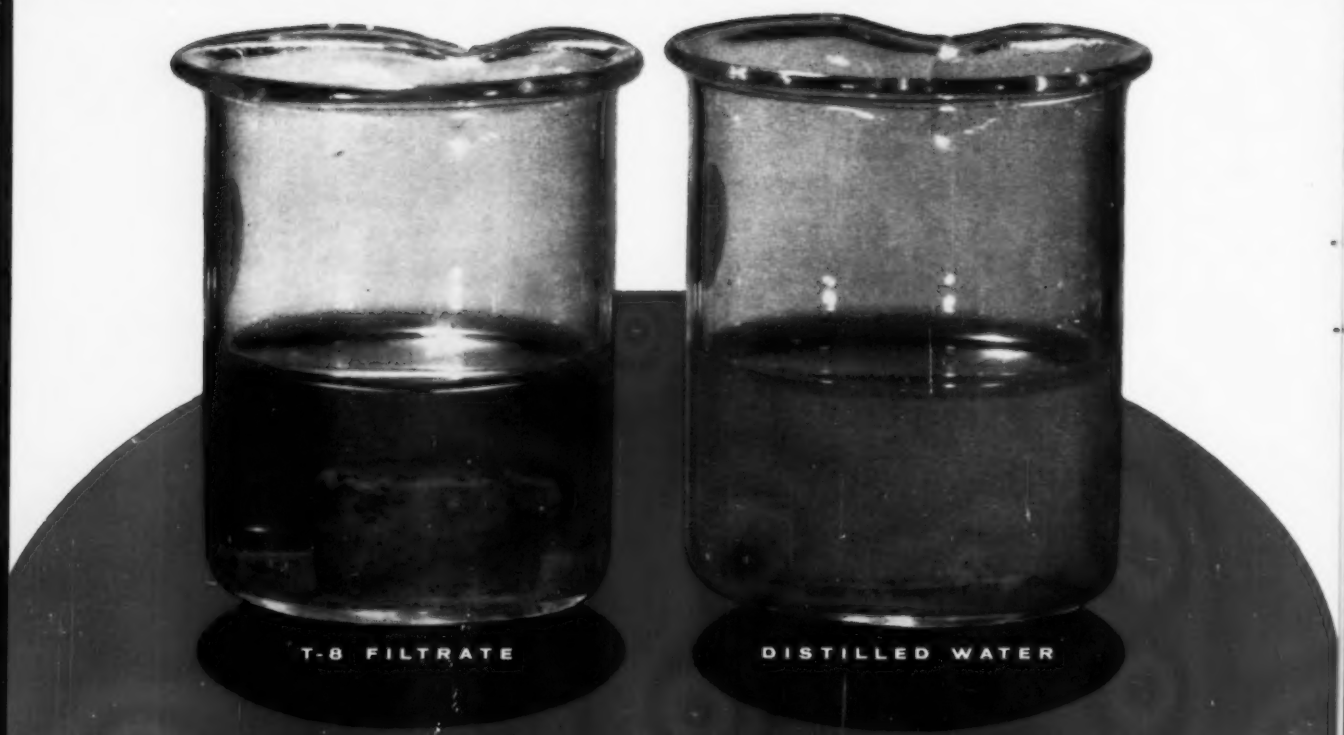

Shale from Bay St. Elaine, Louisiana, exposed to both water and T-8 filtrate. After four days the shale in water had completely disintegrated. In T-8 filtrate the shale showed little tendency to hydrate or disintegrate.

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T-8 lowers overall mud costs. The inhibited chemical environment retards build up of drill solids which reduces water requirements and mud system jetting. Less weight material is required, and smaller amounts of chemicals are needed to maintain a good mud.

T-8 builds a mud system that is in a state of "controlled dispersion" when operated within the proper chemical limits. Control of the mud and the handling of materials are simpler than with conventional mud systems. And because T-8 mud has a higher resistivity than high pH lime mud, you'll get better log interpretation and correlation. Also, production has been increased by T-8 mud because hydration of "dirty" sands is retarded and the penetration of mud solids into the sands is reduced.

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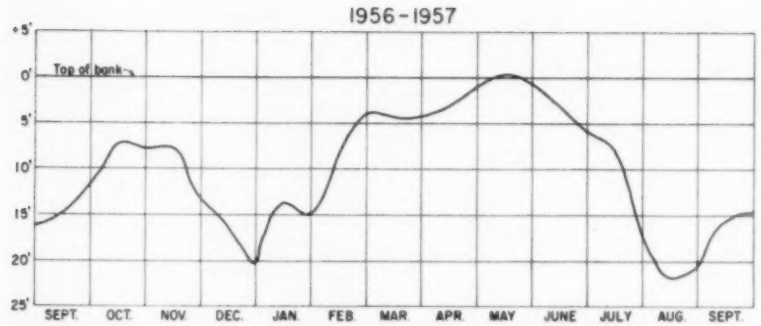


FIG. 2. **Levels of Rio Tigre** at Well 110-1 location. In May the river topped the river banks. This well was completed. The Marañon 22-1, however, was abandoned because of the high water.

recent uplift of the Amazonian plains.

Well locations were sited on local natural levees formed by past seasonal flooding of the sediment-laden Marañon River. The mean amplitude of the river approximates 26 ft between high and low water months. Thus, seasonal and flash floods would be a hazard to drilling sites along the river course unless the area has the advantage of elevation over this mean rise. Well 22-1, lacking this advantage, was flooded out while drilling in April 1956. Fig. 2 shows water levels relative to the top of the bank at location Marañon 110-1 which is near the confluence of the Tigre River with the Marañon River. At this location, August and September are the low water months and March through June is the flood period. These periods vary throughout the Oriente, depending on the drainage area.

Stratigraphy

The tests were located across the structural grain of the Marañon Basin. A thick Tertiary sequence of continental and lacustrine red beds conformably overlie the Cretaceous. These red beds consist mostly of mottled claystone, siltstone and loose sand in monotonous repetition. Considerable anhydrite is locally present. The Tertiary cover requires deep drilling, particularly in the western sector, in order to penetrate the prospective Cretaceous formations. It thins eastward. In the western mountain front sector, the Cretaceous consists of intercalated shale and sandstone (Cachiyacu formation), Sugar sandstone (Vivian), shale and limestone (Chonta) and massive sands (Agua Caliente - basal Cretaceous). The entire Cretaceous sequence becomes sandier eastward. Several Paleozoic formations were penetrated in Marañon 110-1. The oldest is probably of Lower Ordovician age and consists mostly of black argillites.

Marine Equipment

To make the long journey from the U. S. into Eastern Peru via the Amazon River, the light drilling rig was loaded aboard an LSM at Houston, Texas. The LSM is a wartime landing craft of 720 gross tons and has overall dimensions of 203 by 34 ft. The trip from the U.S. to Iquitos, Peru, was made in 49 days. Two houseboats, a fuel barge 110 by 30 ft, a 160-hp auxiliary boat and a 450-hp 600-ton tug boat were in the area having been used by the seismic crews previous to the arrival of the drilling rig.

Drilling Equipment

The light drilling rig, which was transported more than 2000 miles up the Amazon River into Eastern Peru, was especially designed for operation in this area. Four trailers mounted on athey tracks carried the heavy units. The individual trailers were constructed to handle the equipment as shown below.

a. Power trailer — four diesel engines equipped with torque converters and compounded through a four engine drive unit. Total hp: 760; Weight: 26 tons.
b. Drawworks trailer — 320 hp drawworks rotary table and rotary drive. Weight: 27.5 tons.
c. Mast trailer — 97 ft cantilever type telescoping mast. Weight: 22.5 tons.
d. Pump trailer — one 6¾ by 12-in. and one 7½ by 14 in. slush pump, electric generating set accumulator unit and two air compressors. Weight: 41 tons.

Two bulldozer tractors, one with a hoist, were used for clearing locations and for moving equipment.

Other major pieces of equipment included a 200 bbl steel mud tank with separate mixing and circulating sections, cement mixing pump with calibrated tanks, electric wireline winch with instrument cab for logging and two 500 bbl bolted steel tanks for storage of water and diesel fuel. Each of these units was skid mounted.

The arrangement of units a, b, and c is shown in a rigged up condition by Fig. 3. The pump power is provided by the drawworks drive group through a universal drive to each pump. Thus, the power group provides pump and

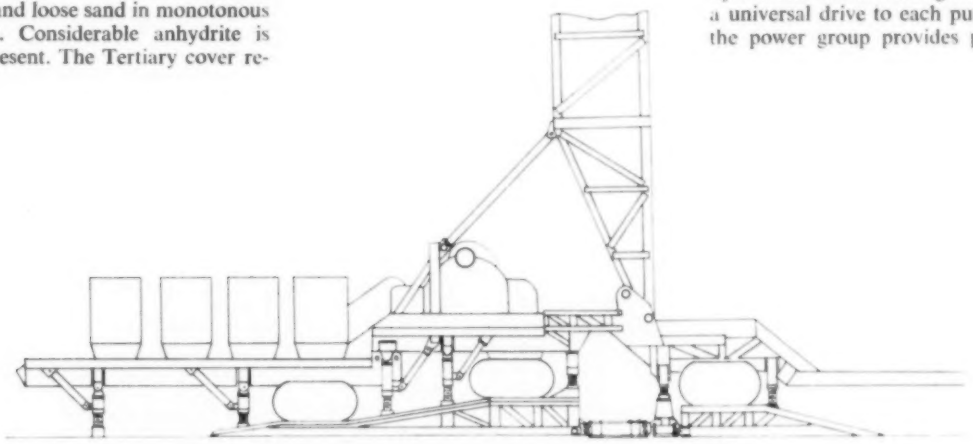
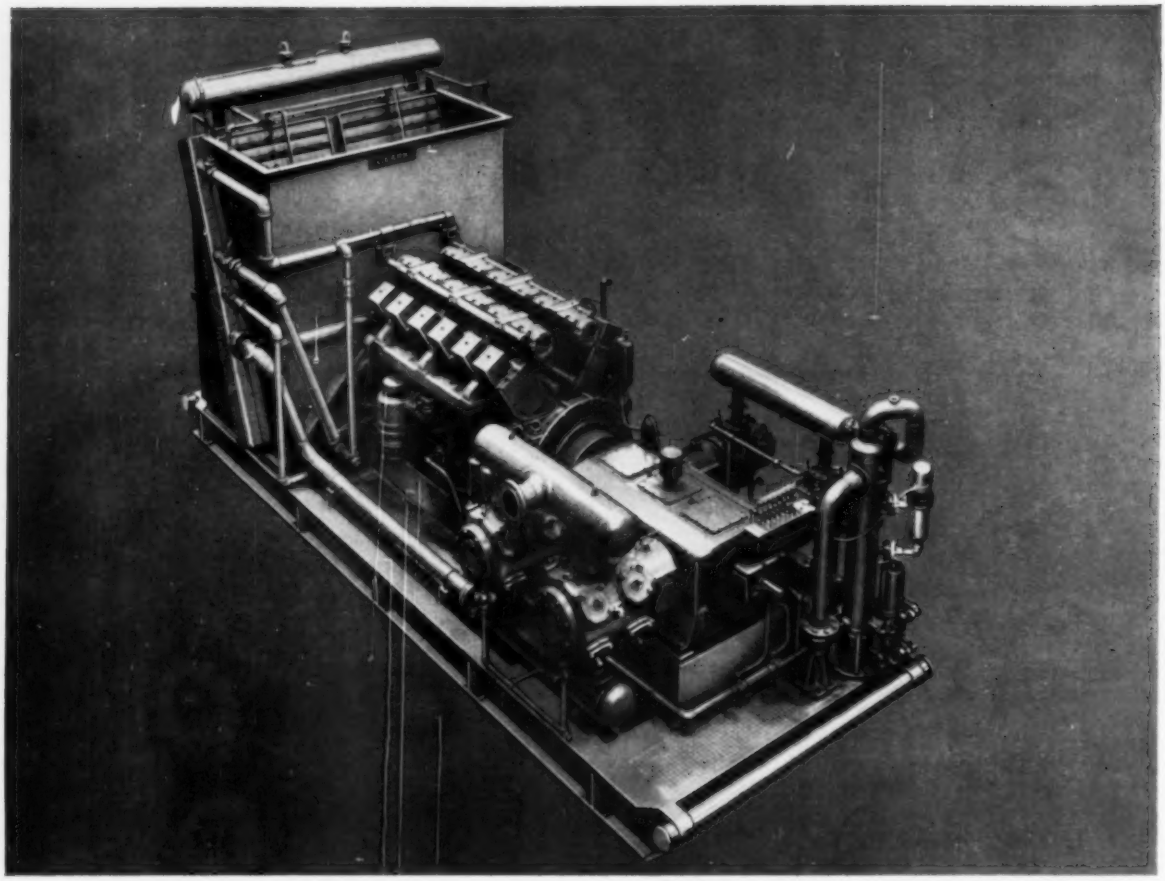


FIG. 3. **Drilling rig** shows power, drawworks and mast trailers in rigged-up position. Three main trailers were mounted in athey tracks. Other equipment was skid mounted.



The Clark model CFA-4 is a completely self-contained compressor station. It is built in eight sizes ranging from 200 to 350 bhp.

Clark CFA balanced/opposed compressors are completely packaged for rugged field service

Portable, proved and popular, Clark CFA compressors are specifically built for air drilling, gas lifting, gas gathering, boosting, testing, repressuring, and other exacting oil-field services. These packaged units are available in two and four cylinder models, in sixteen sizes, covering a range of 100 to 350 bhp.

Direct drive assures greater efficiency

In the CFA, Clark engineers have done away with power-robbing, troublesome gears and belts between the engine and the compressor. A simple rubber block coupling takes their place. This direct drive feature is made possible by the perfect balance of the Clark CFA. It explains how the compressor can operate at a modern 1000 rpm. The direct drive design is also responsible for considerable reduction in skid size and in housing costs.

Balanced/opposed design eliminates vibration

Compressor cylinders are mounted on opposite sides of the crankcase and are connected to crankthrows which are 180° apart. With this arrangement, reciprocating masses, which are of equal weight, are always moving in opposite directions. Because there are no unbalanced forces, vibration is practically non-existent and operating costs are cut down and kept to a minimum.

Easier to install, move or shelter

Since the CFA is a self-contained compressor station, installation presents no problem. Just enough concrete to level the unit is all that is required. Clark CFA's are excellent compressors for swamp country, as well as barge and truck mountings. For air drill-

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ing, you can even mount the compact CFA on timbers. It won't "walk" away.

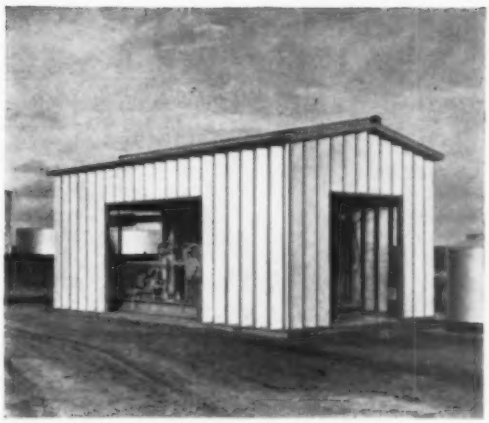
Unitized radiator simplifies cooling

All cooling services are efficiently handled by the unitized radiator built right on the skid . . . and include engine water jacket, compressor cylinder water jacket, lube oil cooling, and as required, inter and after cooling of the gas stream.

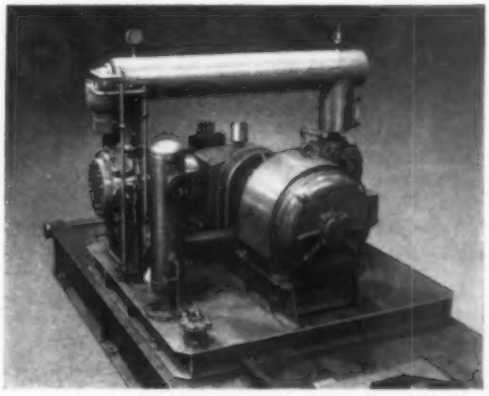
CFA contains many "big compressor" features

Into the sturdy Clark CFA have been built many "big compressor" features. These include a steel crankcase, a one-piece forged steel crankshaft, forged steel connecting rods, precision bearings, and forced feed lubrication. You will find that you'll deplete the field, but you won't wear out the Clark CFA.

The Clark *encyclopedia of experience* – in design, manufacture, and application is always at your service. For complete data on all CFA balanced/opposed compressors, call your nearby Clark engineer. Or write today for the new Composite Catalog, Bulletin No. 151 to Clark Bros. Co., 1205 Lincoln Avenue, Olean, N. Y. Clark is one of the Dresser Industries and maintains sales and service outlets in principal cities throughout the world.

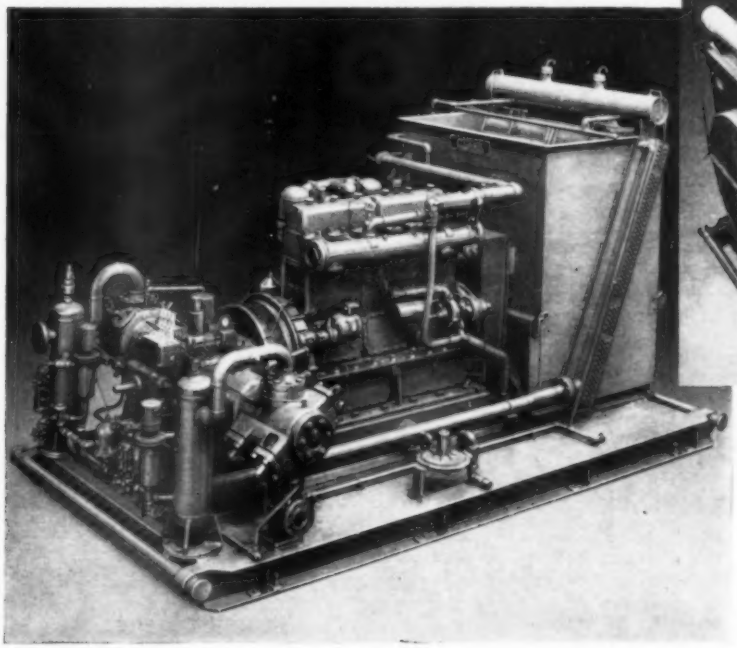


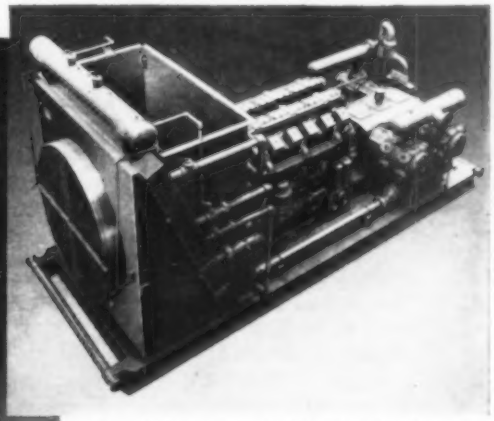
Here a 128 bhp Clark CFA-2 does heavy duty in a field installation for gas gathering. Note the simple installation.



The CFA-2 is also available in electric motor driven units if desired. Illustrated is the 100 bhp model.

Below: **The completely packaged CFA-2 comes in eight sizes ranging from 100 to 200 bhp. No costly field assembly is required.**





The unitized radiator in this CFA-4 handles *all* cooling services in one efficient operation. Piping is confined to skid for maximum protection.

CLARK

THE AUTHORS

Andrew H. Allbee *is a graduate of Iowa State College with a BS in chemical engineering. He has served in various assignments in Venezuela since 1949, and for the past two years has been drilling engineer for Texas Petroleum Company operations on the western coast and in the interior of Peru.*

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rotary power while drilling and drawworks power when pulling pipe.

Drill Stem

The drill stem consisted of 3½-in. OD Grade N-80 EUE tubing, 10.2 lb per ft, 0.289-in. wall thickness and 2.922 in. ID. This tubing was equipped with special Acme 6 pitch threads and 4½ in. OD N-80 couplings 6.625 in. in length. Original couplings were non-hardfaced but replacement couplings were banded with 1-in. of tungsten carbide.

Drill collars were 5¼ by 2¼-in. API full hole with 3½-in. integral tool joints. The smaller size was replacement of eight 5¼-in. collars which were lost in the first well drilled. It has been the practice to run from 5 to 10 joints of 3½-in. 13.3 lb per ft drill pipe above the drill collars and below the kelly to provide extra stiffness in the top and bottom of the string.

Drilling Statistics

In general, the drilling programs for the three wells called for a 9.5⅝-in. surface hole with 7.5⅝-in. 26.4 lb per ft API casing set at approximately 1700 ft. Below the surface casing a 6¾-in. hole was drilled to total depth. Table 1 is a summary of the three Marañon wells.

It was apparent early in the first well, Marañon 8-1, that anhydrite, particularly prevalent in the Lower Tertiary, and swelling clays were creating serious drilling problems. A depth of 6048 ft had been reached in 31 days when periodic reaming of the hole became necessary. The TD of 9787 ft was reached in 98 days. The remaining 62 days were spent in attempting to ream to bottom and in an unsuccessful fishing job.

TABLE 1. Summary of Texpet Marañon Wells.

Well	Days	Surf. casg.	T.D.	No. bits	Mud	Remarks
M-8-1	160	1780	9787	72	Lime	Abandoned—mech. difficulties
M-22-1	69	1762	9196	37	Lime	Abandoned—high water
M-110-1	196	1516	11,537	184	Oil base	Abandoned—dry hole

The second well, Marañon 22-1, some 95 miles to the east of 8-1, encountered similar problems but the well was abandoned because of high

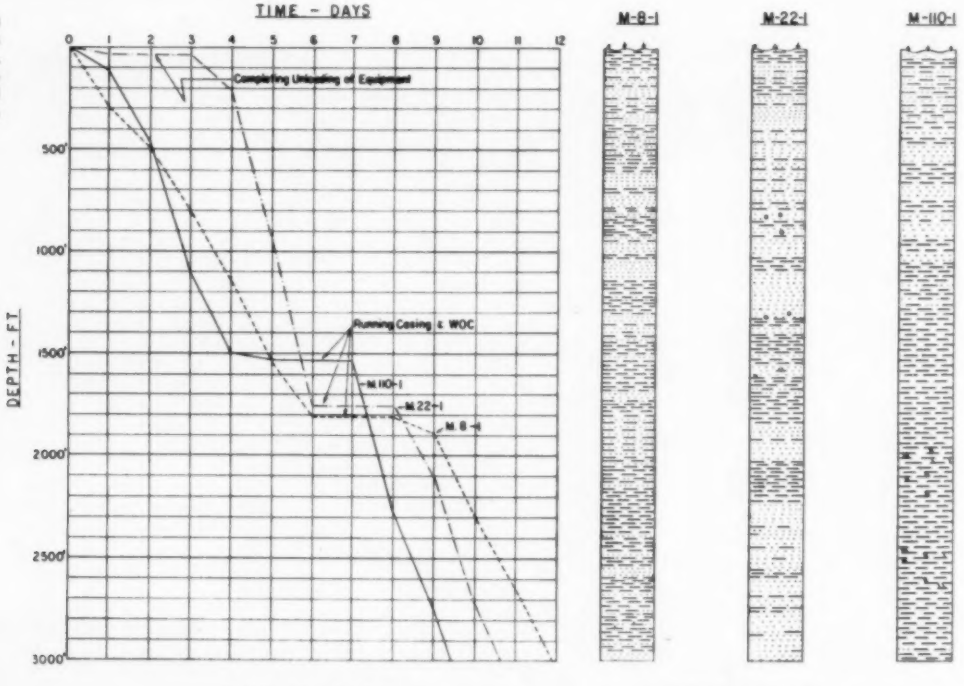

FIG. 4. **Time vs depth** for the three test wells from 0 to 3000 ft. Graphic logs show type of formation penetrated (Tertiary red beds in each case).

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The centralized controls on National Supply's new diesel electric rigs are easy to operate.

New National DIESEL ELECTRIC Rig designed for drilling to 25,000 feet!

...especially suitable for offshore service!

Here's the big first in a new series of National Supply Rigs designed for electric application! It's the 1625DE, built for drilling from 16,000 to 25,000 feet, using 1⅜" or 1½" wire line, and utilizing 1,300 to 2,000 horsepower delivered through electric motor drives.

This is one of the offshore platforms on which a National 1625DE Rig is in service.

In the 1625DE, you'll find all the field-proved features of National Rig construction combined with a simplified, highly flexible power package. Because of its light weight and compact hook-up, this completely integrated drilling system is a natural for offshore service, where platform space is expensive.

National's 1625DE draw works is basically a one-piece design on an 18-inch beam base. Its front and rear sections are detachable for easy transportation, and it includes these outstanding features:

Centralized controls—The draw works' continuously variable control and rotary torque control are centralized and simplified for easy operation. The flexibility of electric power permits infinite speed control with fewer steps on the draw works.

Four hoisting speeds—Transmission shaft carries two drives to the drum, and motor drive rear section includes primary shaft with two selective speed chain drives. Drives are arranged to obtain most efficient use of power and insure fastest operation in line with good drilling practice. Two speeds are available to catheads (and sand reel, if used) and rotary drive.

Large integrally grooved spooling drum—36″ x 61¼″ drum permits hoisting 135 ft. stands of pipe with eight lines without spooling more than three layers on the drum . . . has National Spirallel Grooving, surface-hardened at points of wear.

K-62 Compound Equalizing Brake—Designed especially for this size drum, this National drum brake is the most efficient one in the industry.

Air friction clutches—Used on the drum shaft to provide ease of operation and eliminate shock

continued next page

Overhead view of the rig at left shows more National equipment in service.

Dependable National Slush Pumps help keep mud system costs to a minimum.

New National DIESEL ELECTRIC Rig

(continued)

loading. A special National feature is a jaw clutch built inside the low drum clutch for standby purposes.

National Type A Catheads—Years of trouble-free service have proved the high quality of these important draw works elements.

Draw Works Electric Motor Drive—For the 1625DE, power may be two or three 625/650 h.p. DC motors or two 1,000 h.p. motors—coupled at the rear of the draw works.

NATIONAL 1320DE RIG ALSO AVAILABLE!

The 1320DE is another diesel electric draw works available in the National line. It is designed for drilling from 13,000 to 20,000 feet, and incorporates the same outstanding features of the 1625DE. For complete information on either of these rigs, contact the National Supply representative in your area.

This is the drive group section that complements the 1625DE shown on the previous pages. National Drive Groups are factory pre-aligned, easy to hook up and tear down. Each section is a completely self-contained unit and adaptable to any power source of appropriate size.

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SPANG STEEL PIPE AND ELECTRICAL CONDUIT

water before serious hole trouble developed.

Marañon 110-1, about 173 miles east of the first attempt, was drilled with oil base mud below 3600 ft and although anhydrite and swelling clays were again present, the hole remained in excellent condition throughout the 196 day period.

Fig. 4 shows the comparative total time for drilling each well to a depth of 3000 ft. The graphic logs show the type of formation penetrated (Tertiary red beds in each case). Each of the wells was drilled with water base mud to the depth shown. Conventional 9.5⅝-in. long tooth bits were used for the surface hole and 6¾-in. jet bits of similar tooth design were used below the surface casing. Moderate weights and rotary speeds of 10,000 lb and 200 rpm were generally used in drilling these sections.

Fig. 5 shows a section in the Paleozoic at Marañon 110-1 which was drilled with oil as the drilling fluid. High weights of 22-25,000 lb and a low rotary speed of 100 rpm were the general practice in drilling this section. The bit record for this section is shown in Table 2.

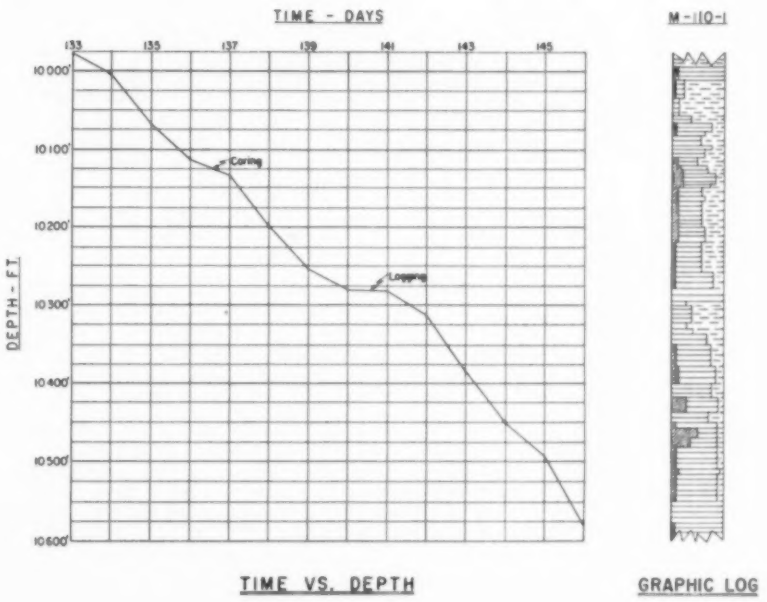

FIG. 5. **Time vs depth chart for Well M-110-1** between 9933 and 10,619 ft. High bit weight, low rotary speed and oil as the drilling fluid was the general practice in this section.

Drilling Mud

The major drilling problem in Eastern Peru has been that of finding a suitable drilling fluid. A high percentage of anhydrite complicated by badly swelling clays are characteristic of the Lower Tertiary red beds. The attempts to solve this problem were, at times, hampered by shortages and long delivery of supplies. Table 3 is a summary of the mud programs for each of the three wells.

First appearance of anhydrite was noted at 5250 ft in M-8-1 and this was treated with barium carbonate. When supplies became available, conversion to lime treated mud was made. Undergage hole caused by swelling clay necessitated repeated reaming in order to return to bottom, until a depth of 9787 ft was reached after 98 days on location. Continuous reaming from then on failed to reopen the hole and no further footage was made. On numerous occasions pipe was stuck and it was necessary to pull up to 175,000 lb to free the pipe. This operation was climaxed by a failure of the drill tubing and the well was abandoned after unsuccessful attempts to recover 8 drill collars, 10 joints of 3½-in. drill pipe and 52 joints of 3½-in. drill tubing.

Similar conditions existed at the second location, M-22-1. With adequate supplies on hand, conversion to lime treated mud was made as soon as anhydrite appeared. Much improvement was noted in hole conditions as a result although swelling still caused tight hole and some reaming was necessary. At one time drill collars were eliminated and the bit went to bottom with little difficulty. It appeared from this that tight hole conditions were made more severe by the relatively small clearance between the 5¼-in. drill collars and the 6¾-in. hole bore.

The third well, M-110-1, was drilled with oil as the drilling fluid below 3600 ft and while similar conditions existed most hole problems were eliminated. Because of the late arrival of the oil additive supplies, it was necessary to convert to lime mud when anhydrite appeared. Conversion to oil base was made with 9.5 lb per gal mud. Moderate hole caving made it necessary to increase the weight to 11.5 lb per gal before the caving was brought under con-

TABLE 2. Bit Performance — Marañon 110-1 9933-10,619 Ft.

Bit No.	Type bit	Ft drilled	Hr on bit	Ft per hr
139	OWS	72	26.75	2.65
140	OWS	109	36.50	3.00
10	HF (core)	13	6.50	2.00
141	OWS	156	50.50	3.09
142	OWS	172	48.50	3.53
143	OSC-3	164	44.50	3.66

TABLE 3. Summary of Mud Programs for Three Wells in Eastern Peru.

			Average properties			
Well	Interval	Type mud	Weight lb/gal	Viscosity sec.	F.L. cc	Total cost
M-8-1	0–6065	Water-clay	10.3	43	7.4	$45,850
	6065–9320	Oil emulsion	10.6	66	5.6	
	9320–9787	Lime treated	11.0	52	3.9	
M-22-1	0–4796	Water-clay	10.2	48	7.1	$23,972
	4796–9196	Lime treated	12.0	56	4.0	
M-110-1	0–2500	Water-clay	10.2	52	6.9	$57,449
	2500–3600	Lime treated	10.4	60	6.0	
	3600–11,537	Oil base	12.0	100	0.2*	

Note: One hr fluid loss.

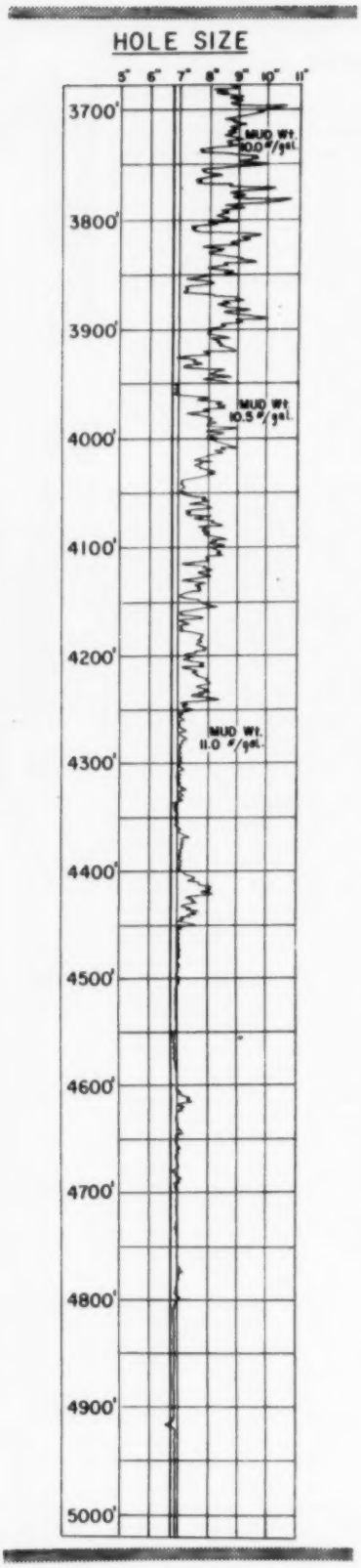

FIG. 6. **Caliper log** for Marañon 110-1 well. Note the effect that weighting the mud has on formation caving tendency.

trol. The hole drilled with this mud remained "in gage" to TD. Fig. 6 is a caliper log showing the effect of weighting the mud to control caving.

Diesel oil used in the mixing oil had an aniline point of 192 F and required the addition of a special oil to reduce this property to about 150 F at which point the asphalt in the powdered additive would dissolve completely and rapidly. The usual ratio was about 2.37 to 1, diesel oil to special oil, or 18 gal diesel oil to 8 gal of special oil in each barrel mixed.

Some difficulty was experienced in screening the cuttings. A 20 mesh screen was first used but excessive mud loss over the shaker resulted. A 10 mesh screen was substituted and while this eliminated the mud loss it allowed a considerable amount of cuttings to settle out in the ditch and tank. A 14 mesh screen now available should bring relief on future wells.

Mud viscosity ranged between 90-120 sec API down to 10,000 ft and additions of new mud to the system served to control a gradually rising weight and viscosity. At about this depth the viscosity became virtually impossible to control by this means and reached 180 sec API. Weight had also increased to 12.7 lb per gal even though make up mud was unweighted. The mud was thinned down with a straight mixing oil treatment and although the fluid loss increased to 4.5 cc (1 hr) further treatment with new mud soon brought the filter loss down to 1.0 cc. The reduced viscosity of 110 sec API and mud weight of 12.3 lb per gal held reasonably well from 10,400 ft to TD.

Various factors contributed to the difficulty in controlling the viscosity, fluid loss and much weight. Among these were:

a. Solids build up because of inefficient screening of cuttings,

b. Bottom-hole temperature of 240 F and flow line temperature of 160 F,

c. Aging of mud after 120 days of use,

d. Continuous working of the wall cake into the mud stream from the many round trips and whipping of the pipe below 9200 ft where deviation of the hole was somewhat excessive.

The non-conductive oil circulated in M-110-1 required the use of induction logging together with a gamma ray log (for additional lithologic definition) and a neutron log (for porosity and additional fluid data). The gamma ray-neutron log was run in the open hole. Conventional electric logs were run in the lime treated mud of the first two wells.

Drill Tubing

Use of 3½-in. 10.2 lb per ft tubing in the drilling string has been considered successful. Lighter weight pipe has enabled the drawworks which is rated by the manufacturer at 6500 ft with 3½-in. drill pipe to drill to a depth of 11,537 ft. While the hydraulics below 10,000 ft are rather poor, there was no evidence that the hole was not being kept clear of cuttings. Table 4 shows the pressure loss at various circulation rates and depths. It has been estimated that the circulation pump, rated at 1600 psi with the minimum sized 4¾-in. liners, will produce a maximum circulation rate of 210 gpm at 11,537 ft or an annular velocity of 157 ft per min.

TABLE 4. Hydraulics of 3½-in. Tubing String Using 12.3 lb per gal Oil Mud.

Drill stem	Bore	GPM	Ft/min	Pressure loss—psi			
3½" tubing			(Annulus)	6000'	8000'	10,000'	12,000'
8-4¾" x 2¼" DC's	6¾"	220	163	1050	1305	1560	1810
8-5¼" x 2¼" DC's	6¾"	200	150	870	1082	1292	1505
Conv. tricone bit	6¾"	180	137	728	896	1068	1238

The fishing operation previously mentioned resulted from the severe strains imposed on the pipe while pulling through the tight hole in M-8-1. Weight indicator readings often were 175,000 lb or more (185,100 lb minimum yield strength). The pipe parted in an upset immediately below a coupling while pulling at 90,000 lb. Of the 5542 ft lost, 3400 ft were recovered. One coupling and pin washed out while drilling the first well but these have been the only failures in 30,520 ft of hole.

Wear of the original non-hardfaced couplings has been considered moderate and 22 have been replaced. Wear is checked with a simple "go-no go" gage of 4⅛-in. diameter. Some elliptical wear has also been noted but only 4 or 5 couplings have been replaced for this reason. It is expected that most of the remaining non-hardfaced couplings will be replaced before 40,000 ft has been made with this string. The hardfaced couplings show very little wear, and the oldest of these have been in use during the last two wells or a total of 20,733 ft. ★ ★ ★

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Retrievable 1-in. macaroni string and "snorkel" mandrel solve unusual gas lift problems of: (1) Long perforated intervals; (2) very low bottom-hole pressures; (3) large casing sizes; (4) very old oil strings; (5) low producing rates, and (6) need for low cost

Special insert chamber and one-inch eductor tube used in . . .

Producing Stripper Wells by Gas Lift in PERU

H. W. Winkler
Camco, Inc.,
Houston, Texas

P 515.21

DESIGN of an unusual gas lift installation has provided the answer to some of Peru's difficult stripper well producing problems. Use of a 1-in. macaroni string as an eductor tube inside 2-in. tubing combined with a special landing nipple with pack-off and cross-over mandrel and down-hole chamber increased production in about 300 wells. Fig. 1 shows schematically the gas lift system employed. These problem wells were plagued with long perforated intervals, extremely low bottom-hole pressures (bhp), large casing sizes, very old oil strings (30 to 40 years old) and low daily producing rates.

Field trial installations. Compania Petrolera Lobitos (whose Peruvian producing properties are now operated by International Petroleum Company) in 1952 set aside the South Organos field, near Talara, Peru, as an experimental field to be changed from pumping to gas lift. The 64 wells in this field ranged in depth from 1200 to 2700 ft and were pumped by five central pumping units and 20 individual units. The central power pumping equipment was obsolete and inefficient. A typical rod line pumping unit is shown in Fig. 2. It was proposed to utilize the current gas lift equipment and operational techniques for installing a closed rotative gas lift system. Prior to the development of pressure operated flow valves, open tube gas lift installations had been run in this area of Peru as early as 1930; but operating costs made this form of gas lift prohibitive as the wells' bottom-hole pressures declined.

All of the wells in the South Organos field had been converted to gas lift by 1953. The rotative system was

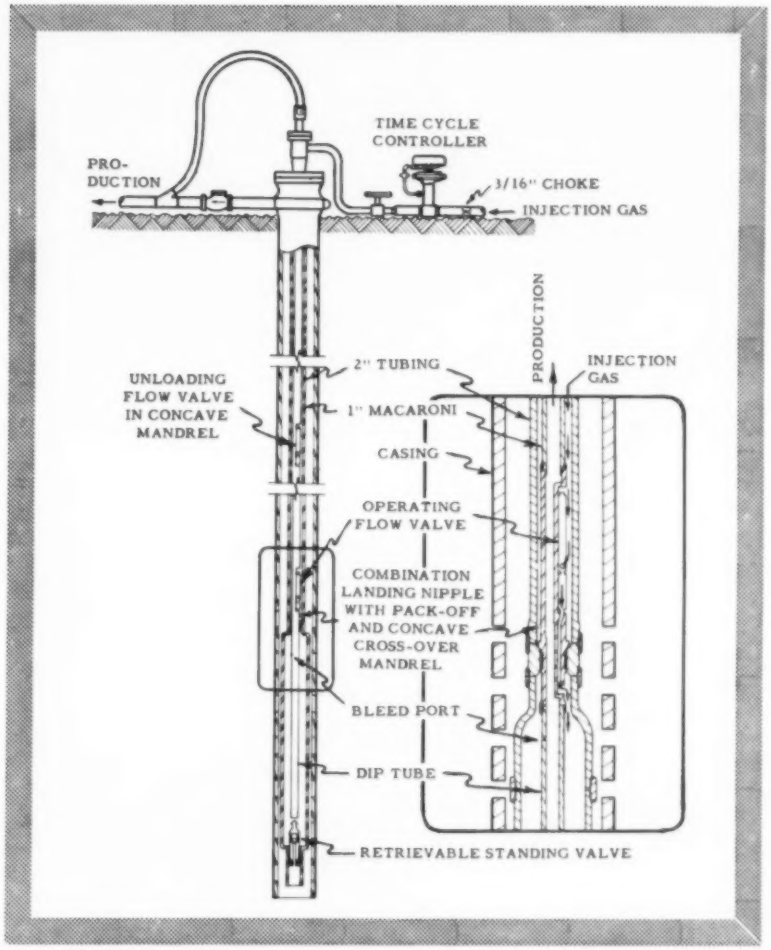

FIG. 1. **Unusual gas lift installation** in Peru with downhole chamber, a special combination landing nipple with pack-off and cross-over concave mandrel for producing through removable macaroni string.

FIG. 2. **Old rod line hookup** employing central power units pumped many wells near El Alto, Peru. This system was replaced by unusual gas lift system.

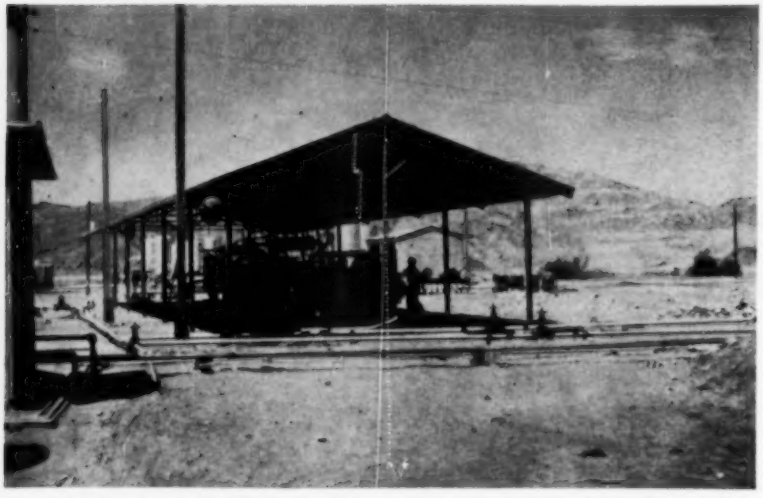

FIG. 3. **Field compressor station** for rotative gas lift operations in the North Organos field. Small skid-mounted packaged compressors were used. A similar compressor station was located in the South Organos field.

FIG. 4. **Well converted to gas lift** in the Restin field near El Alto, Peru. Casing in this well is over 30 years old.

started with 100,000 cu ft per day from the wells on gas lift with no outside source of gas available. Compressors were driven by electric motors with electrical power being furnished by the company-owned generating plant.

Results of the gas lift program were very encouraging. After a year of operation, the South Organos field was producing approximately 750 bbl of oil per day which was 16 percent higher than estimated from the decline curve for pumping operations. Daily production was no longer erratic but relatively constant due to the flexibility of the individual gas lift installations. Operation of the central pumping stations had required a total of 20 men in three shifts over a 24-hour period. Only five men were needed to operate the gas lift system. It had been necessary to pull the pumps for servicing about once each month due to a sand condition. Servicing the gas lift equipment had been negligible.

Based on results observed in the South Organos field, a wide-scale conversion from pumping to gas lift began in October 1954. Closed rotative systems were designed for gas lifting wells in other fields. Fig. 3 is a photograph of the compressor station in the North Organos field. By September 1955, approximately 300 wells were on gas lift.

Compania Petrolera Lobitos had a total of about 1200 wells producing approximately 11,000 bbl of oil per day in 1955. The producing reservoirs are a closed depletion type with extremely low bottom-hole pressure during the latter years of production. It was proposed to continue expanding the gas lift program, but certain well conditions seemed to exclude the possibilities of gas lifting many wells.

Obstacles Facing Gas Lift Operations

Problems associated with gas lifting these wells were:

1. **Lengthy perforated intervals.** Some wells were perforated from the "grass roots" to total depth. A packer installation could not be used.

2. **Extremely low bottom-hole pressures.** The point of gas injection had to be near total depth and would require some type of chamber installation. Excessive wellhead tubing back pressure would restrict fluid entry from the reservoir into the wellbore.

3. **Large casing sizes.** Some wells had tapered oil strings with 14-in. casing on top. A large annulus capacity prevented controlled injection of gas volumes for low daily producing rates with economical injection gas-fluid ratios.

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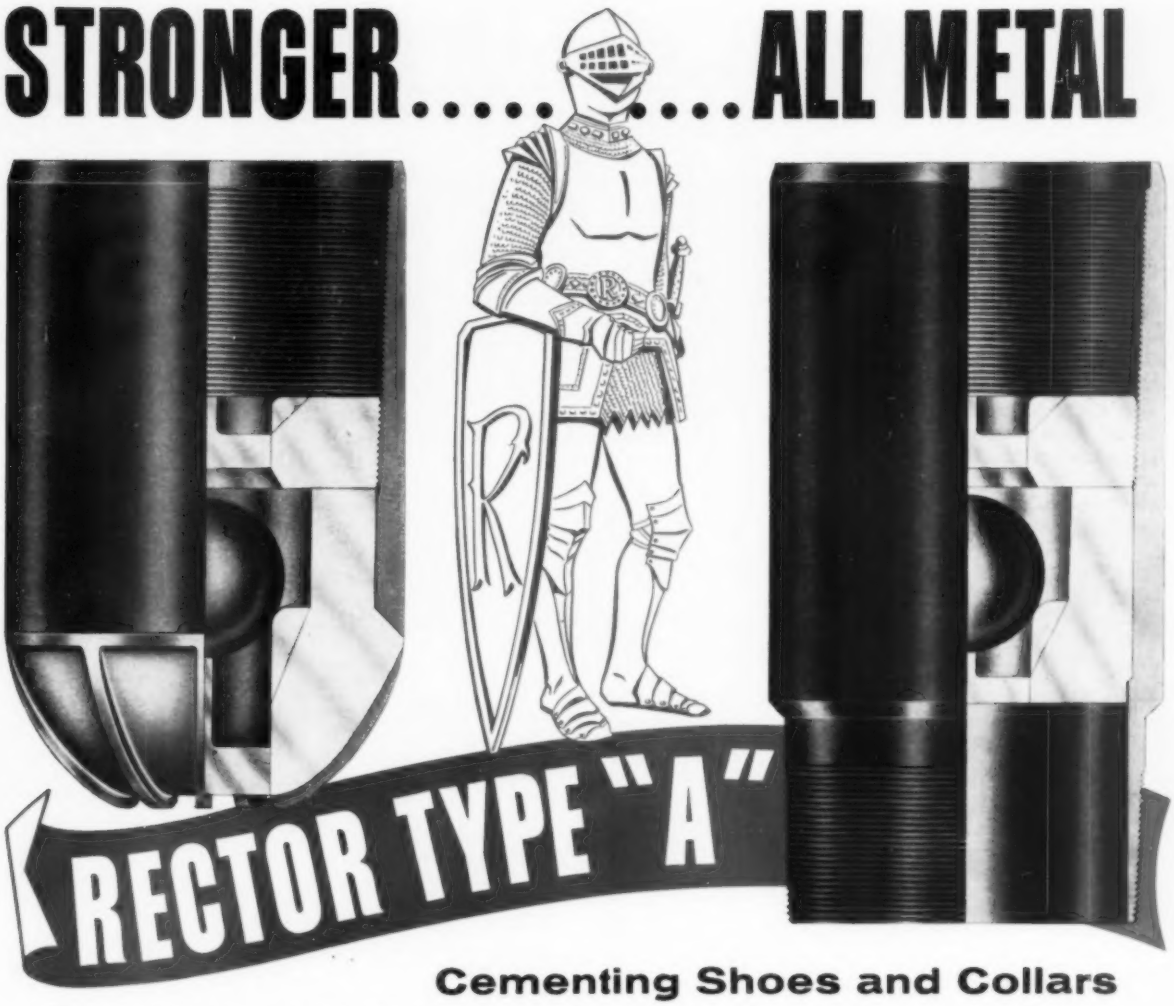

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4. **Old oil strings.** Many wells were over 30 to 40 years old. One of these older wells, which is in the Restin field, is shown in Fig. 4. It was unwise to subject the casings in these wells to injection gas pressure.

5. **Low daily producing rates.** Many wells produced only one or two barrels per day.

6. **Necessity for low installation and operational costs.** Only a small expenditure could be justified due to the low maximum daily recovery.

Gas Lift Chamber Design for Stripper Production

In order to gas lift these wells, a special insert chamber installation was devised which used a 1-in. macaroni string as the eductor tubing. The original design utilized a conventional 2-in. casing flow mandrel, as shown in Fig. 5. The 1½-in. OD pressure-operated valve for lifting the fluid accumulated in the chamber was run in the well on the 2-in. tubing string with the insert chamber, dip tube and standing valve. The 1-in. macaroni and the 1-in. OD pressure-operated valves for unloading in concave mandrels could be run and pulled without pulling the 2-in. tubing and chamber.

A standard 1 25/32-in. ID seating nipple was run between the casing flow mandrel and chamber. The 1-in. macaroni tube would land and pack-off in this nipple. The injection gas traveled down the tubing annulus between the macaroni and tubing, through the flow valve in the casing flow mandrel into the top of the chamber where it displaced the fluid into the macaroni and lifted the oil slug to the surface.

Neither the operating flow valve in the casing flow mandrel nor the standing valve could be repaired or replaced without pulling the 2-in. tubing and chamber. This feature was considered a serious disadvantage since it was imperative that the maintenance cost be low.

"Snorkel" mandrel solves problem. A combination landing nipple with pack-off and cross-over concave mandrel for the 1-in. OD pressure-operated flow valve was developed in 1955. Photographs of one of the first "snorkel" mandrels made and named by field personnel in Peru is shown in Fig. 6 and 7. The photo in Fig. 6 shows the essential components of the mandrel and pack-off assembly. Fig. 7 illustrates the assembled position of these components prior to welding.

All operating gas lift equipment could be pulled without pulling the 2-in. tubing and chamber by using the "snorkel" mandrel and a modified standing valve. The bottom end of the standard 2-in. seating nipple for the standing valve was pinned to prevent the standing valve from passing through it. The no-go shoulder was removed from the retrievable standing valve in order that the valve would pass through the 2-in. seating nipple above the chamber. A schematic illustration of this type of installation is shown in Fig. 1.

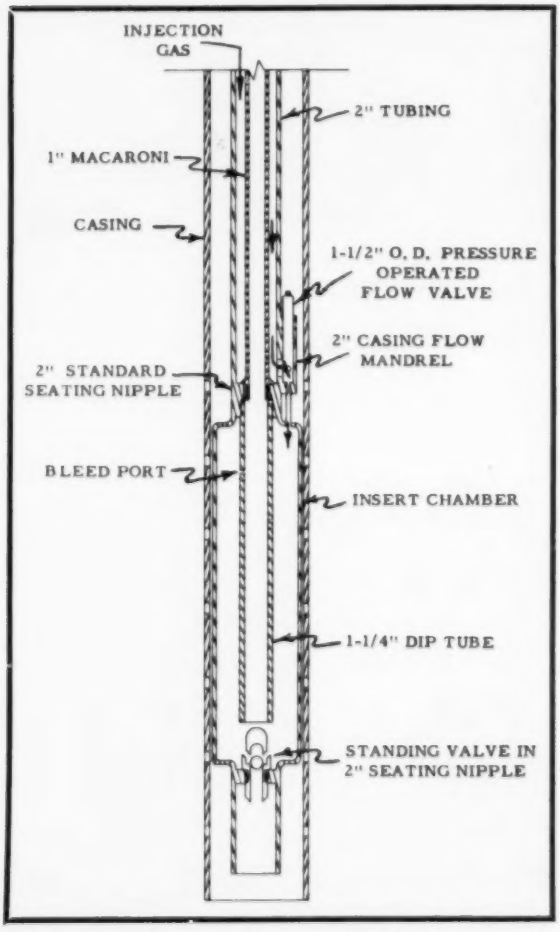

FIG. 7. **Assembled components,** pictured in Fig. 6, prior to welding together.

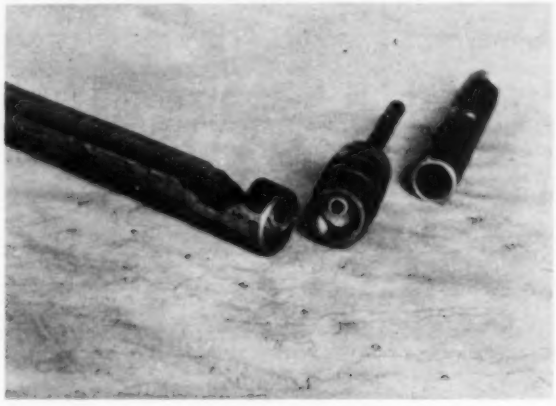

FIG. 6. **Components of a combination landing nipple** with pack-off for a 2-in. seating nipple and a 1-in. cross-over concave mandrel.

FIG. 7. **Assembled components,** pictured in Fig. 6, prior to welding together.

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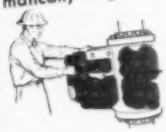

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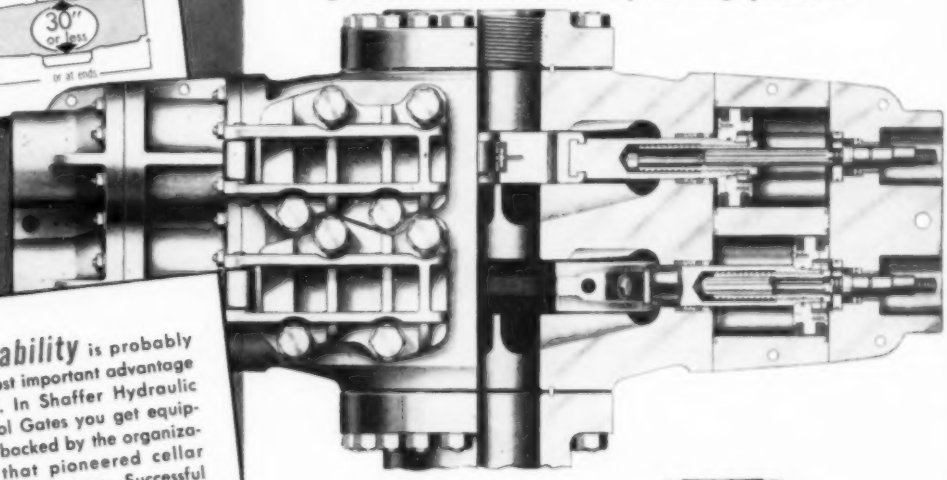

CUTAWAY VIEW showing direct hydraulic drive and self-draining ram compartments

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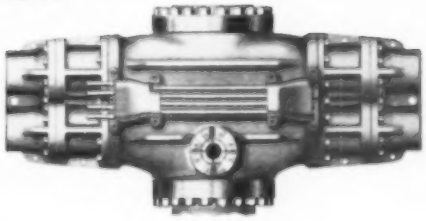
REAR VIEW showing simplicity of hydraulic manifolding for operating the gate.



SHAFFER Mud-Free Design prevents detrimental mud accumulations from interfering with free opening and closing of the rams. Note how each ram travels on high, narrow guide ribs above the steeply-sloped compartment bottoms so that mud and sand quickly drain back into the well. Also, this design permits well pressure to flow to the back of each ram, thus actually assisting the ram sealing action.

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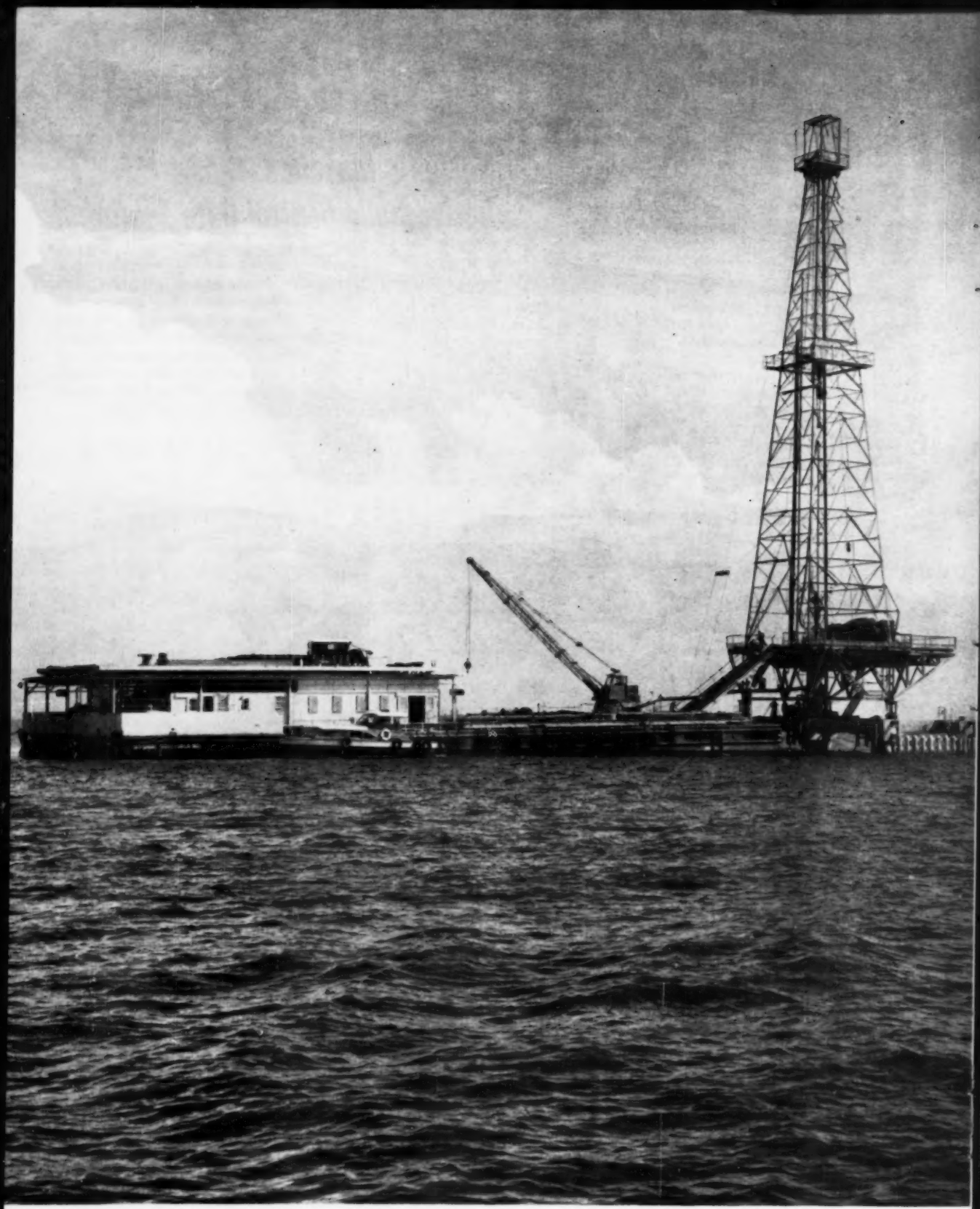

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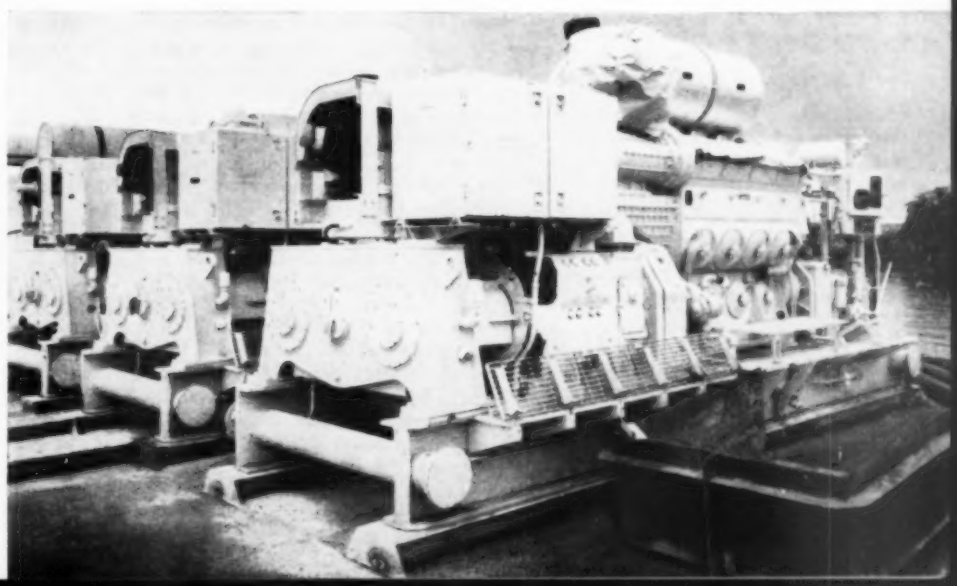

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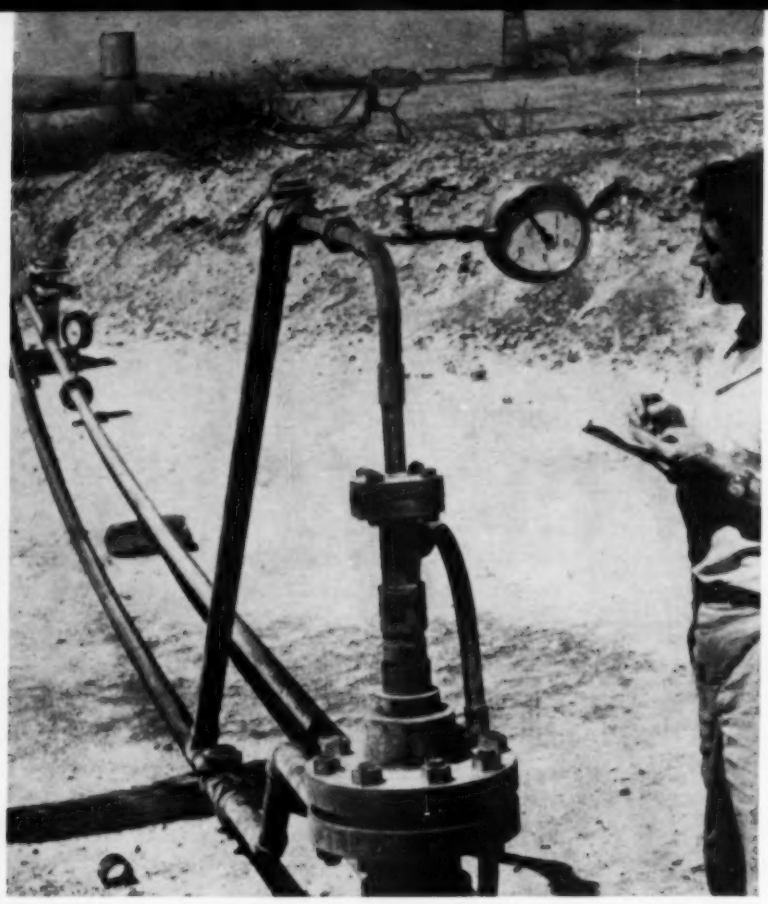

FIG. 8. **Checking gas lift performance.** Field foreman recording slug velocity and maximum and minimum tubing pressures during injection cycle for chamber installation similar to Fig. 1.

Advantages of the Special Chamber Design

Principal advantages of the chamber installation using a macaroni eductor tube with combination landing nipple and cross-over mandrel for stripper production are:

1. This type of installation permits gas lifting wells from total depth regardless of the length of perforated interval.

2. Pressure against the formation is a minimum because the casing annulus can be connected into the flow line or vented.

3. It permits efficient intermitting of low fluid level wells by converting a few feet of fluid in the chamber to several hundred feet of fluid inside the macaroni.

4. Casing is not subjected to the injection gas pressure.

5. It eliminates running a hook-wall packer, thus reducing the costs of the initial installation.

6. Wells with large casing size may be lifted through a macaroni tube using the tubing annulus for injection gas without excessive injection gas-fluid ratios.

7. Pulling costs are one-quarter to one-third as much as a conventional packer installation. Pulling the macaroni, complete with flow valves and pack-off, is the same as pulling rods.

8. The per minute injection gas requirements to open the operating flow valve are less because the injection pressure in the small tubing annulus will approach line pressure rapidly.

9. Operating cost of this type installation is extremely low.

Injected Gas Requirements

It is essential that the injection gas requirements be kept to a minimum for stripper production on gas lift. A comparison between the minimum gas passage through a flow valve on 2-in. tubing in 7-in. casing with that of the same valve on a 1-in. macaroni inside 2-in. tubing illustrates the importance of the smaller annular capacity for injection gas. For a 2000-ft well, the capacity between the 1-in. and 2-in. tubing is approximately 25 cu ft as compared to 400 cu ft between the 2-in. tubing and 7-in. casing.

If the difference between the valve opening and closing pressures is 45 psi, the volume of gas passed through the valve in the small tubing annulus would be approximately 75 cu ft as compared to 1200 cu ft if the valve were in the casing annulus. This assumes that no gas is passed through the valve during the injection pressure build-up. If the well produced only 0.25 bbl per cycle, the injection gas-fluid ratio would be 300 cu ft per bbl for the macaroni installation and 4800 cu ft per bbl for the packer installation.

Lifting Low Fluid Level Wells

The chamber design shown in Fig. 1 remains efficient with extremely low bottom-hole pressures. Advantage of this type installation can be illustrated by considering the producing data for a typical well. Assume the following well data to be representative at the time the chamber is installed:

- 1-in. line pipe inside 2-in. upset tubing.
- Operating injection pressure = 400 psig.
- Wellhead tubing back pressure = 30 psig.
- Producing bhp = 150 psig (before valve opens).
- Static fluid gradient = 0.4 psi per ft.
- Producing 30 bbl of fluid per day.
- 3½-in. nominal line pipe (4-in. OD) for insert chamber.
- Capacity of 1-in. = 1.07 bbl per 1000 ft.
- Annular capacity between 1-in. and 3½-in. nominal = 10.55 bbl per 1000 ft.

Calculating chamber length. Chamber length can be calculated as follows for an insert chamber bottomed near total depth:[1]

$$\text{C.L.} = \frac{P_i - P_f}{\text{S.G.}(R)} = \frac{400 - 150}{0.4\ (9.86)} = 63 \text{ ft}$$

Where:

- C.L. = chamber length, ft,
- P_i = injection pressure, psi,
- P_f = producing bhp, psi,
- S.G. = static gradient, psi per ft,
- R = ratio of annular capacity of chamber to capacity of eductor tube.

Determining starting slug volume. The theoretical volume of the starting fluid slug can be determined by calculating the volume of the chamber plus the volume in the 1-in. eductor tube and dip tube for a bottom-hole pressure of 150 psig and a tubing pressure of 30 psig. This starting volume for a 63-ft chamber and 0.4 psi per ft gradient is nearly one barrel. Fluid level in the 1-in. macaroni would be approximately 300 ft above the bottom of the chamber immediately prior to the opening of the flow valve.

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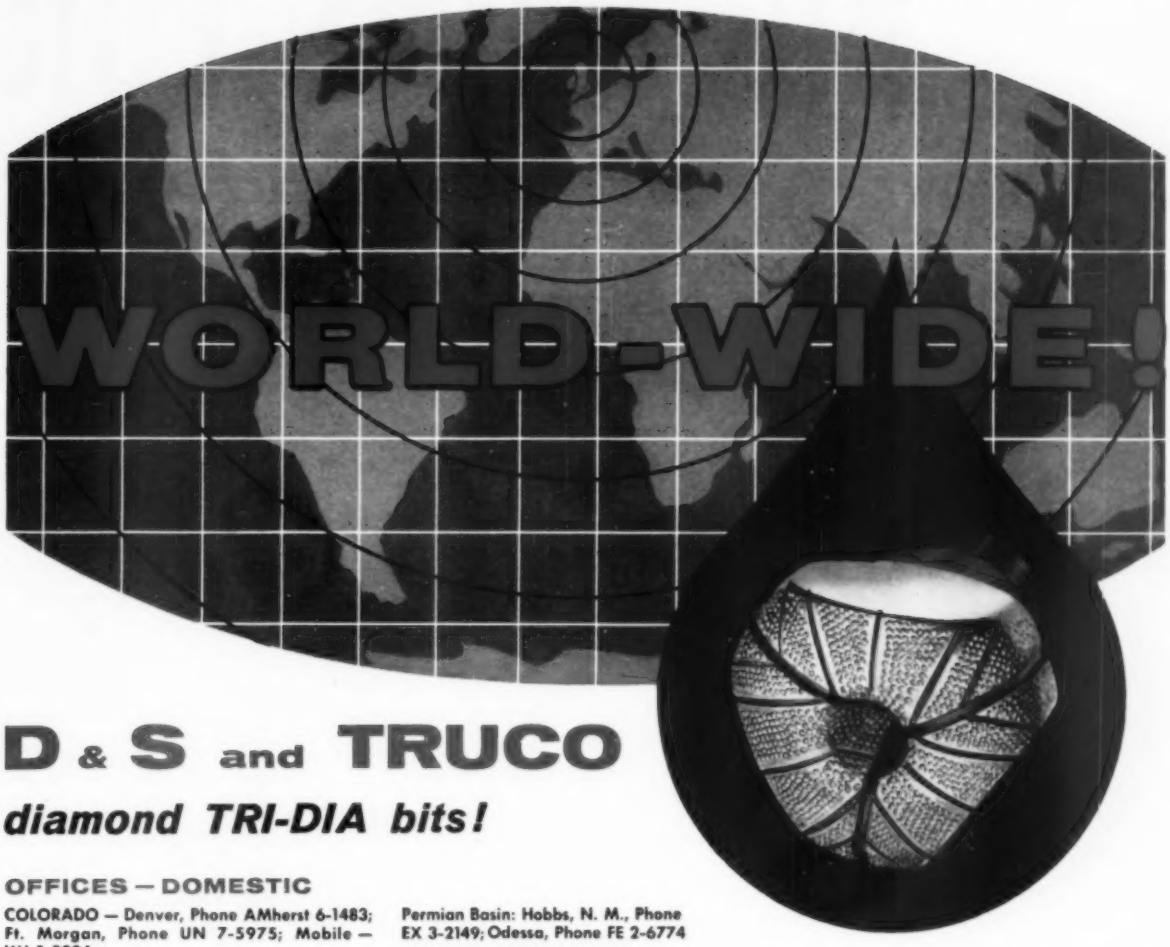

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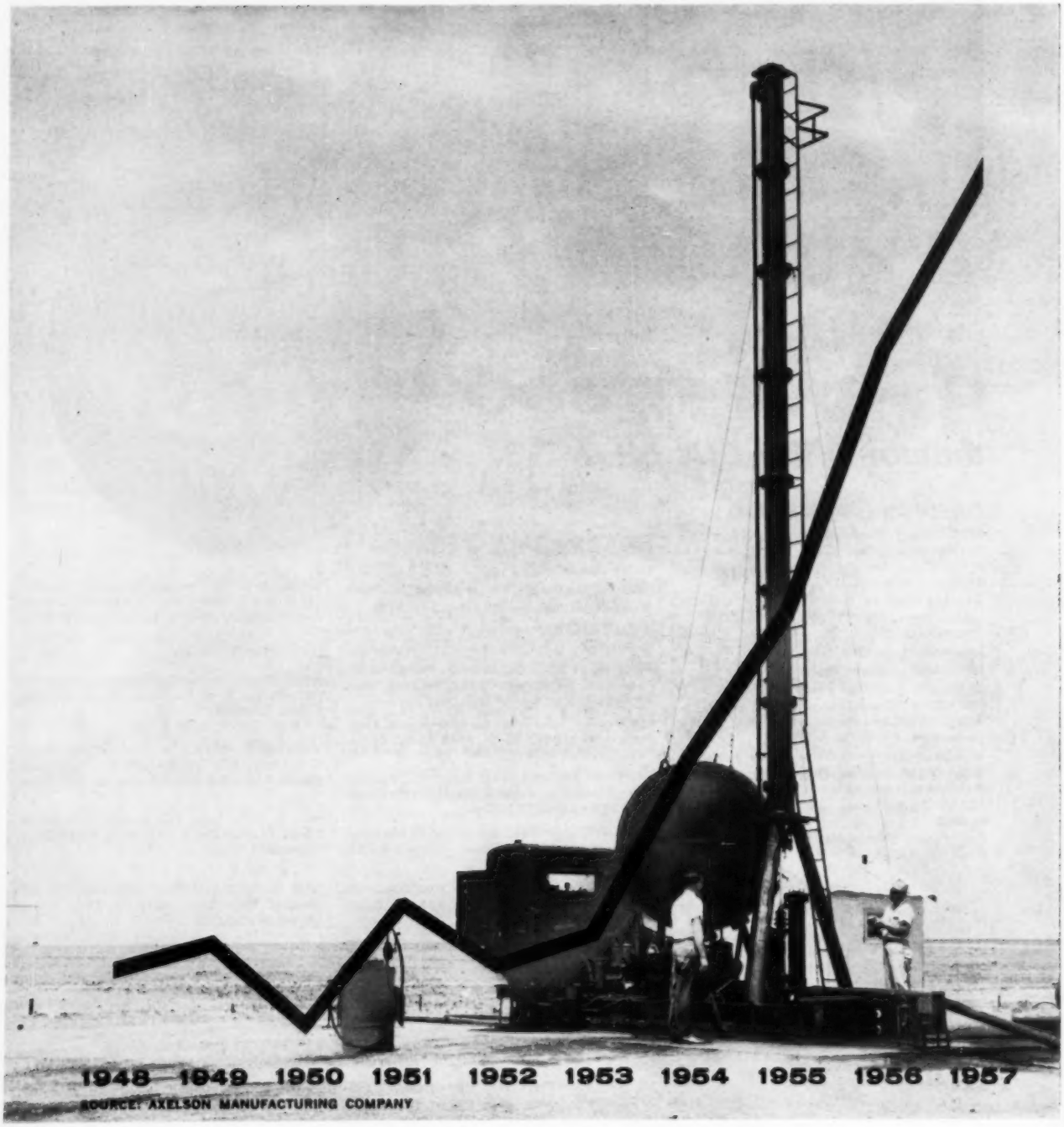

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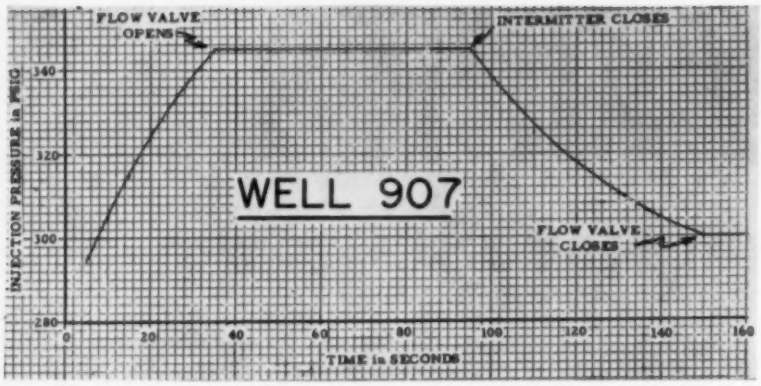


FIG. 9. **Time versus injection pressure** during complete injection gas cycle for chamber installation similar to Fig. 1. Chamber is not filling between injections.

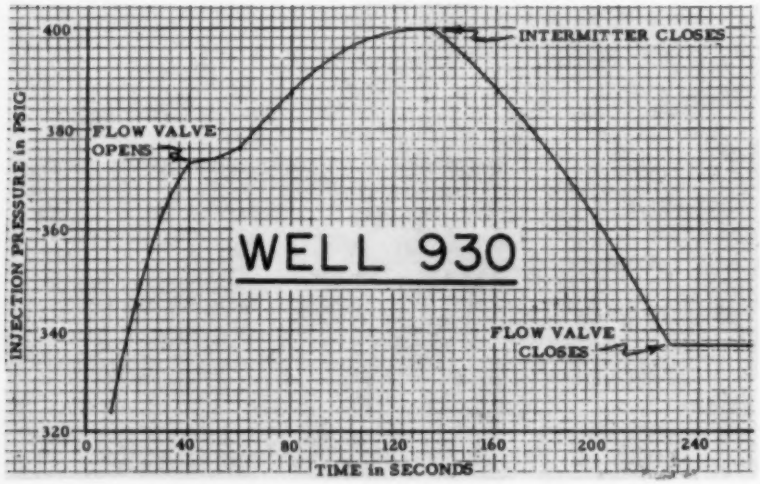


FIG. 10. **Time versus injection pressure** during complete injection gas cycle for chamber installation similar to Fig. 5. Chamber is filling between injections.

As the well is produced, the bottom-hole pressure declines. Now, assume the bottom-hole pressure has decreased until the working fluid level between gas injections builds up only to the top of the chamber. This represents a producing bottom-hole pressure of approximately 55 psig. The starting volume would be over two-thirds of a barrel. Although the working fluid level has decreased from 300 ft to less than 65 ft (producing bhp from 150 psig to 55 psig), the starting slug volume has reduced less than one-third of a barrel. Many wells in Peru on gas lift have a producing bottom-hole pressure of less than 50 psig which makes this type of installation essential.

Field Tests

Several wells with gas lift installations similar to Fig. 1 and 5 were checked during the summer of 1957. These installations had been in operation for 18 or more months without being serviced. Injection pressure versus time, maximum and minimum tubing pressures, time required for slug to surface, and daily production were recorded. Field foreman in Fig. 8 is recording the slug velocity and range of tubing pressure for an injection cycle.

Time versus injection pressure was plotted for at least one complete injection cycle for each well checked. These plots were used to analyze the gas lift operation. Two of these plots are shown in Fig. 9 and 10. Zero time on the abscissa is the instant at which the intermitter opens, and the injection pressures are the tubing annulus pressures at the surface downstream of the choke during an injection cycle. Fig. 9 is a plot for Well 907 in which the chamber is not filling between gas injections. The injection pressure remains constant after the valve opens and the production per cycle represents approximately 50 percent of the total capacity of the chamber.

The chamber in Well 930, Fig. 10, is filling completely between injections. The injection pressure continues to increase after the valve opens and the well is producing more oil per injection cycle than the capacity of the chamber and dip tube. There is no doubt that the slug originates in the chamber because there is only one flow valve in the well. Fluid level is building up above the chamber between gas injections. The injection gas cycle frequency could be reduced for Well 907 and increased for Well 930.

Representative data for eight wells tested are given in Table 1. All of these wells have the "snorkel" type mandrel, as shown in Fig. 1 and 6, unless otherwise noted.

Production per cycle was calculated by dividing the total average daily production by the number of injection cycles per day. Volume of the chamber includes the capacity of the dip tube plus the annular capacity of the chamber for the length of the dip tube.

Injection gas was supplied to the tubing annulus through a 3/16-in. positive choke. The choke and small annulus permit accurate surface recording of flow valve opening pressures, as can be seen on Fig. 9 and 10, and permit reliable gas volume estimates by knowing the upstream and downstream pressures across the choke.

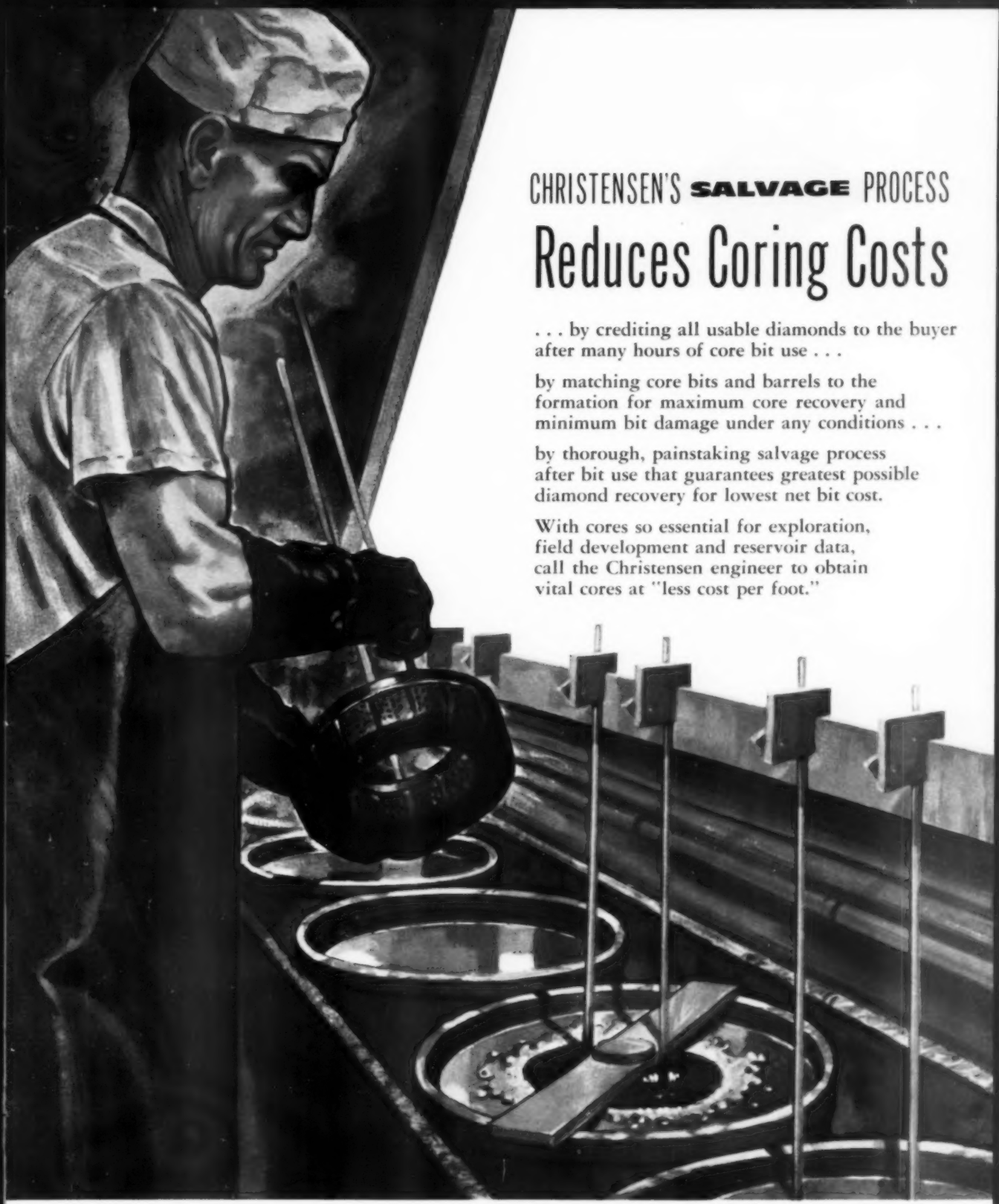
For wells in which the chambers were filling, the injection gas-fluid ratios were in the neighborhood of 300 cu ft per bbl per 1000 ft of lift. Other wells which produced only a small fraction of a barrel per cycle had injection gas-fluid ratios between 500 and 550 cu ft per bbl per 1000 ft of lift.

Purpose of choke. The surface choke

TABLE 1. Performance Data for Eight Gas Lift Wells.

Well No.	Depth of Lift (ft)	Max. Inj. Press. (psig)	Slug Velocity (ft/min)	Prod. per Cycle (bbl)	No. Inj. per Day	Volume of Chamber (bbl)	No. of Flow Valves
299	3800	395	1360	0.20	48	—	Several
907	1630	350	1290	0.26	72	0.55	3
923*	1971	405	740	0.25	24	0.69	1
930*	1513	400	875	0.75	12	0.68	1
1005	2032	290	1220	0.38	96	0.45	3
1319	1221	320	810	0.35	72	0.65	1
1323	1354	361	1085	0.45	96	0.68	2

*These installations are similar to Fig. 5, using a 1½-in. OD pressure operated flow valve inside a casing flow mandrel.



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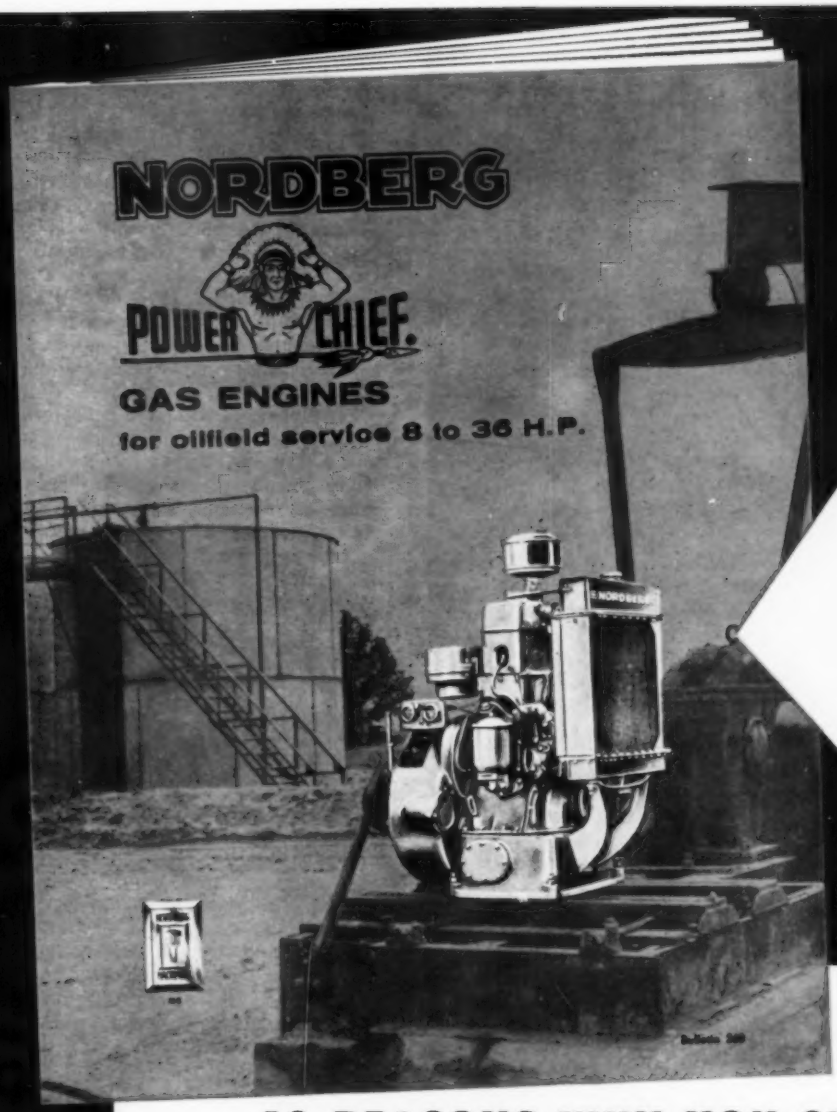

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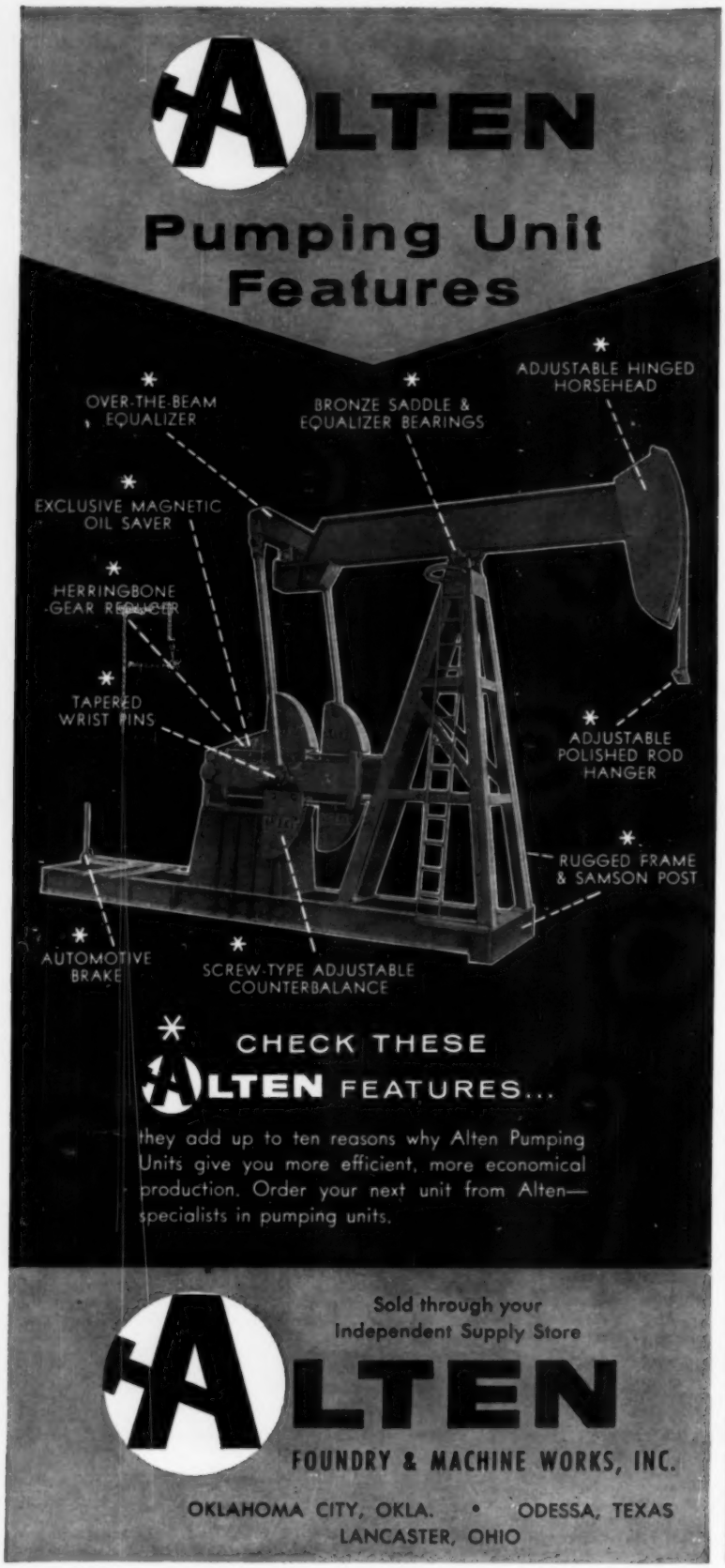
Reference

1. Winkler, H. W., and Camp, G. F., "Down-Hole Chambers Increase Gas Lift Efficiency," *The Petroleum Engineer*, June and August 1956.

Acknowledgment

The author wishes to express appreciation to International Petroleum Company, Ltd., who is operator of these properties in Peru, for permission to publish this paper, and to Danny Docherty, former production superintendent for Compania Petrolera Lobitos, for his assistance in the early work of this project. ★ ★ ★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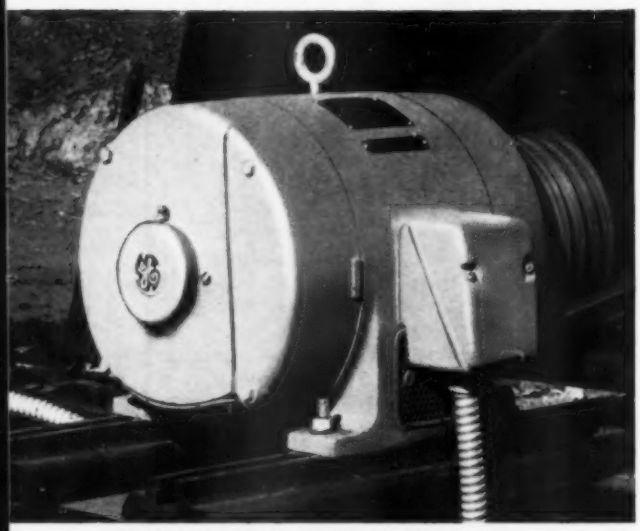

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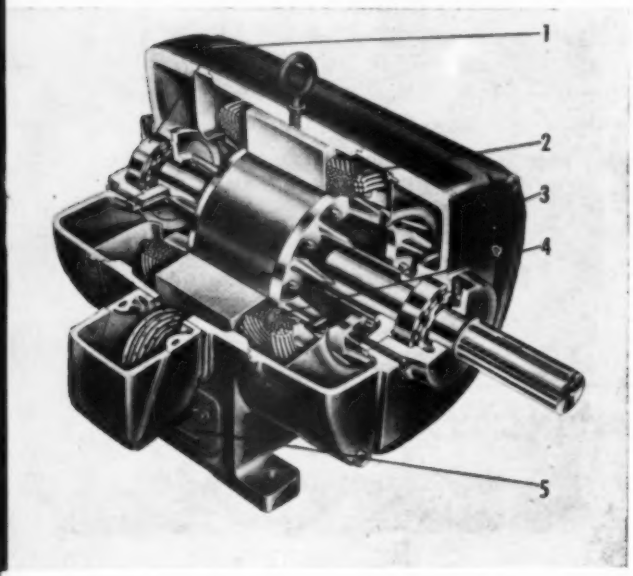

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Cerro de Pasco Petroleum's task: Find, produce and supply oil for Peru's largest fuel consumer

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Lima, Peru

CERRO DE PASCO PETROLEUM Corporation, one of the youngest members of the Peruvian petroleum industry, is pursuing an active exploration program in the Oriente Zone in the same progressive manner that the parent company, Cerro de Pasco Corporation, has been developing the metal resources of this country for over half a century.

The Cerro de Pasco Corporation, which has extensive mining activities throughout the central Peruvian Andes, is one of the largest industrial enterprises in Peru, and is also the largest single consumer of industrial fuel. In 1955, it made the decision to look eastward and "down-hill" toward the tropical rain forest lowlands for a petroleum concession area which, if productive, would provide an economic source of fuel close to the Sierran mining and smelting operations centered at Oroya. At the end of 1956 Cerro de Pasco Petroleum Corporation (Cerropet) was assigned the petroleum activities in Peru. Wm. Ross Cabeen & Associates, a geological and engineering consulting firm with headquarters in Los Angeles, California, is conducting the exploration program.

Surface mapping studies have disclosed at least one-half dozen structures, three of which are presently classified as drillable. Airborne magnetometer surveys suggest the probability of many other drillable prospects. Seismic studies and exploratory drilling are planned to commence within the next two years. Assuming commercial quantities of oil and/or gas are developed, a pipeline is proposed to be layed over rugged but surmountable terrain from Cerropet's concession area to Oroya, and eventually to Lima.

At the outset a few concessions were

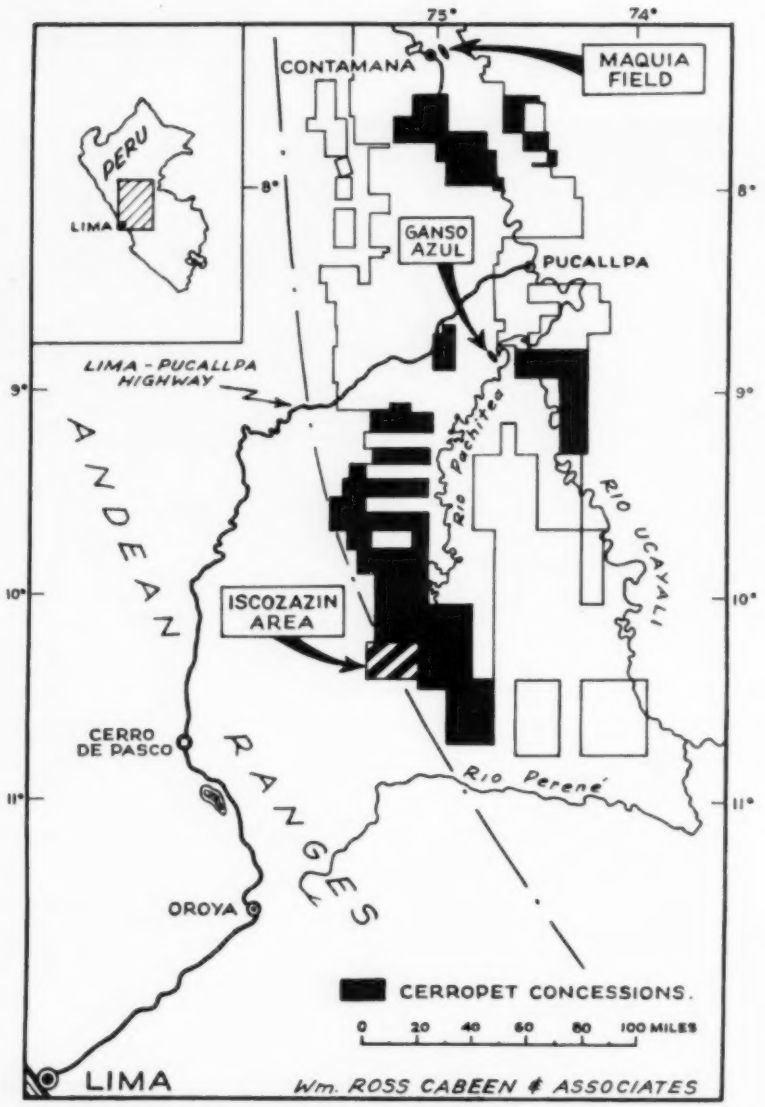

FIG. 1. **Cerropet concession** areas in the Ucayali Basin in relation to existing fields. Oil found would fuel the smelters of the company's parent organization.

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denounced along the foothills of the eastern Andes and were located about 100 miles northeast of Oroya, Cerro's center of operations in the Sierra. By the early part of 1956 a concession area totaling 1,000,000 hectares (about 2,471,000 acres) had been denounced. This concession comprises several blocks distributed within the Ucayali Basin extending a short distance south of the newly discovered Maquía field southward to the Perené River and from the foothills of the Eastern Andes to the Ucayali River. (Fig. 1). The greater part of the concession areas are located immediately east of the eastern base of the Andes and are within 150 miles of Oroya.

Objectives

Cerropet's objectives are unique among the petroleum concessionaires in the Peruvian Oriente because it has a specific market for production close to its concession area. Daily fuel requirements in the Sierran smelting operations are sizable, and the increasing cost of imported fuel and rising freight rates are the prime factors for its developing a supply of its own.

This market and its proximity to potential productive areas require much less daily production and reserves to be developed than required by other major concession holders to warrant construction of a pipeline. A prevalent opinion among Oriente Zone concessionaires is that prior to construction of a trans-Andean pipeline from the Oriente to the Pacific Coast, reserves of 200 to 500 million bbl and a daily production of 100,000 bbl should be developed. One-tenth of these requirements can be economic for Cerro's purposes.

Many companies look to the Marañon Gap, the lowest pass (7000 ft) in the Peruvian Andes, as the logical route for a trans-Andean line. Although this route would serve the Marañon River Basin in the northern part of the Oriente, it is probable that other routes might prove more economic for the Ucayali Basin, which is located in the central part of the Oriente. One such route would be up the Pachitea Valley through Oroya, and then to Lima. This latter pipeline route follows along a relatively natural course, but does pass over some very rugged terrain before going through a 15,000 ft pass and on to Lima. However, experienced pipeline men have examined the route and have pronounced it no more difficult a problem than many they have tackled in other parts of the world.

Cerropet's goal is certainly not limited to supplying its own fuel requirements. What little is known to date indicates that the untapped potential of the Pachitea Basin alone may be in the order of several hundred million barrels. If success in developing large commercial production and reserves is attained, then a pipeline laid to Oroya from the Pachitea Basin to supply the Sierran operations would in time be extended to Lima.

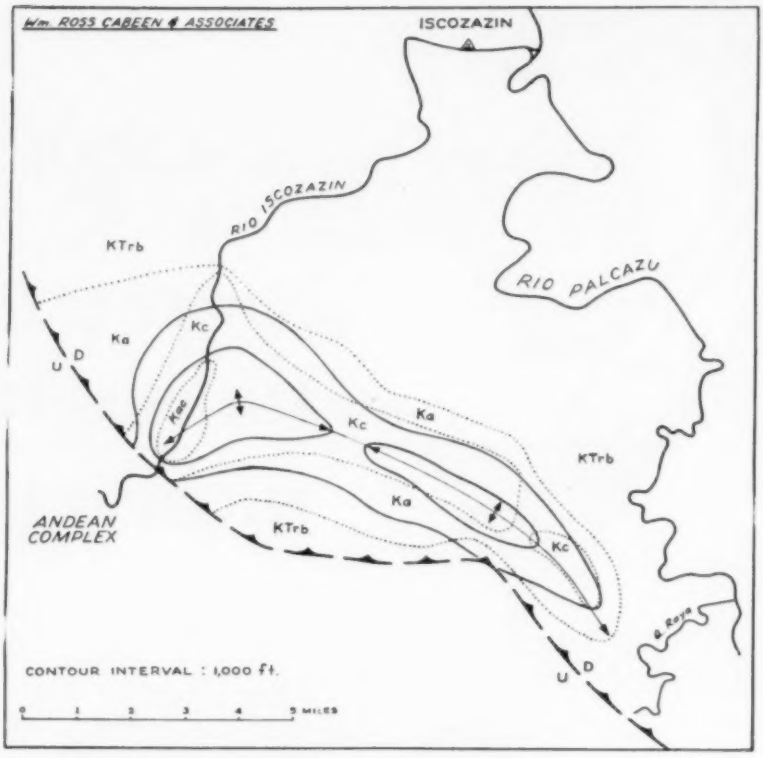

FIG. 2. **Iscozazin Anticline,** generalized surface geology and structural contours. Rocks of Cretaceous age are exposed over the greater part of the anticline. They include: Agua Caliente (Kac) sandstone and shale (Lower to Middle Cretaceous), Chonta (Kc) shale and limestone, and the Azucar (Ka) sandstone (Upper Cretaceous). Redbeds, of Tertiary and Uppermost Cretaceous in origin are indicated by (KTrb).

Exploration Methods

Cerropet's exploration program has proceeded at a rapid pace, and with the exception of seismic and drilling exploration, it has been one of the most active in the Oriente Zone. Emphasis has been placed on geologic surface studies, which will continue to be the major exploration method for the next few years. Surface studies are largely restricted to river courses by means of motor boat or canoe. Detailed studies have required traverses on foot along small streams and trails. Fifty percent of the concessions have been covered during 35 field party months (three two-man parties) since 1955.

Reconnaissance airborne magnetometer surveys, in which Cerropet, Mobil Oil del Peru, and Peruvian Gulf participated jointly, were flown by Fairchild Aerial Surveys, Inc. covering all of Cerropet's concessions as well as adjoining areas. The total area covered is approximately 14,000 sq miles.

A seismic program will be undertaken in the future. Meanwhile, surface geologic studies and magnetometer studies are being used to localize future seismic surveys.

Potential Petroleum Structures

Several large structures have been found by surface geologic methods within concessions close to Cerro's Sierran operations. One of these is the Iscozazin Anticline (Fig. 2) which is located in the center of the province of Oxapampa, department of Pasco, Peru, about 100 miles northeast of Oroya. The Palcazu River, which is navigable to the pueblo of Iscozazin, lies 15 miles east of the structure. This feature was first recognized by photogeologic studies, confirmed by reconnaissance, and then mapped in detail.

Geology

The Iscozazin Anticline is expressed topographically as a long ridge locally known as Cerro Chontilla. The structure lies against the eastern foothills of the Andes and along the east side of the Sub-Andean fault zone. This fault zone separates the structurally complex Andean block on the west from the moderately to gently-folded

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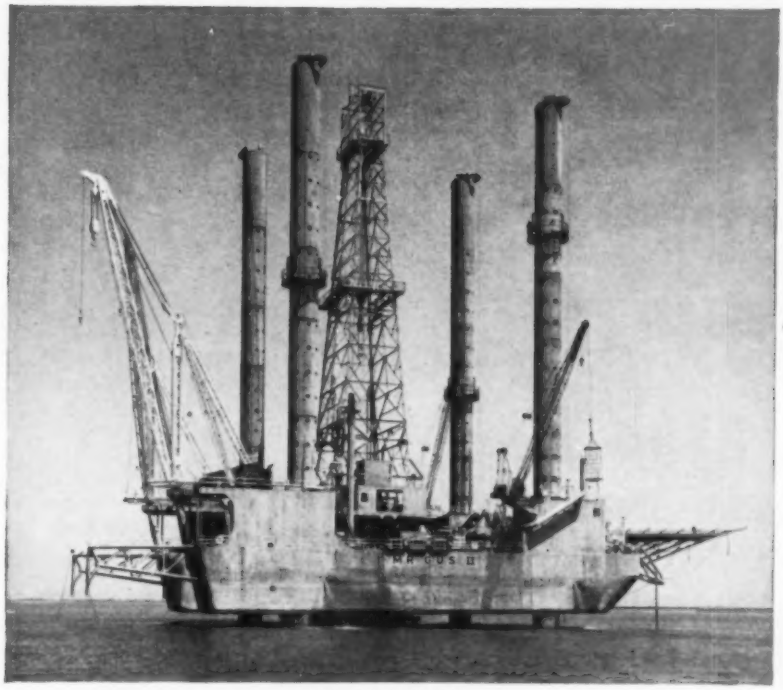

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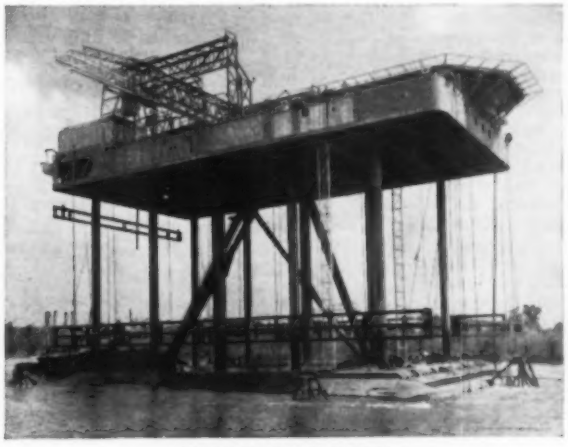

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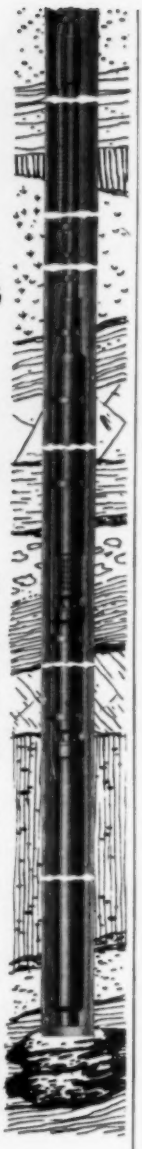

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Ucayali Basin on the east. The Andean block consists largely of Paleozoic and Mesozoic sediments and basement complex. Rocks of Cretaceous age are exposed over the greater part of the Iscozazin Anticline. These include in order of ascendence: The Agua Caliente (Kac) sandstone and shale (Lower to Middle Cretaceous), Chonta (Kc) shale and limestone, and the Azucar (Ka) or "Sugar" sandstone (Upper Cretaceous). Redbeds (KTrb), which are for the most part Tertiary in age but probably Uppermost Cretaceous age in at least the lower part of the formation, surround the structure. The reservoir objective in this structure is the lower part of the Agua Caliente sandstone, which would correspond to the productive interval of the Aguas Calientes dome of Ganso Azul.

Structure

This feature is a relatively symmetrical, doubly-plunging anticline which has an axis convex toward the northeast. The axis trends approximately N 60 deg W in the southeastern portion of this structure, and turns to a more east-west trend in the northwest portion. Dimensions of the anticline are 12 miles long and 6 miles wide. The anticline contains an east and a west dome. The vertical closure exceeds 1000 ft, and the areal closure exceeds 10,000 acres. If this structure is proved productive, an estimate of its potential reserves could be of the magnitude of 50 to 75 million bbl.

Future Program

Cerropet plans a drilling program that will include at least six tests. This program is not scheduled to begin until 1959 or 1960.

If production is obtained in the amount anticipated, the task of constructing a line from the productive area across the Eastern Andes to Oroya will lie ahead. However, once a line has reached Oroya it can be expected that additional production of Cerropet and other companies will soon warrant extending the pipeline from Oroya to Lima, a distance of 120 miles. This then, would be the natural route of crude oil transport in the entire region from the Maquía field southward. The Oroya to Lima line should not present any more difficulty in construction than the proposed pipeline from Bolivia to the Pacific Coast port of Arica, Chile.

In this regard, Cerro de Pasco, with over a half century of mining and engineering experience in the rugged terrain of the Peruvian Andes, considers this problem just another interesting challenge in its share of the program to develop one of the largest remaining potential petroleum provinces in the Western Hemisphere. ★ ★ ★

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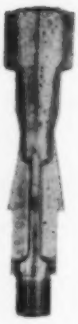

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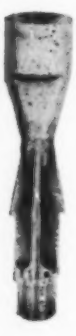

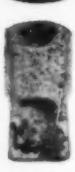

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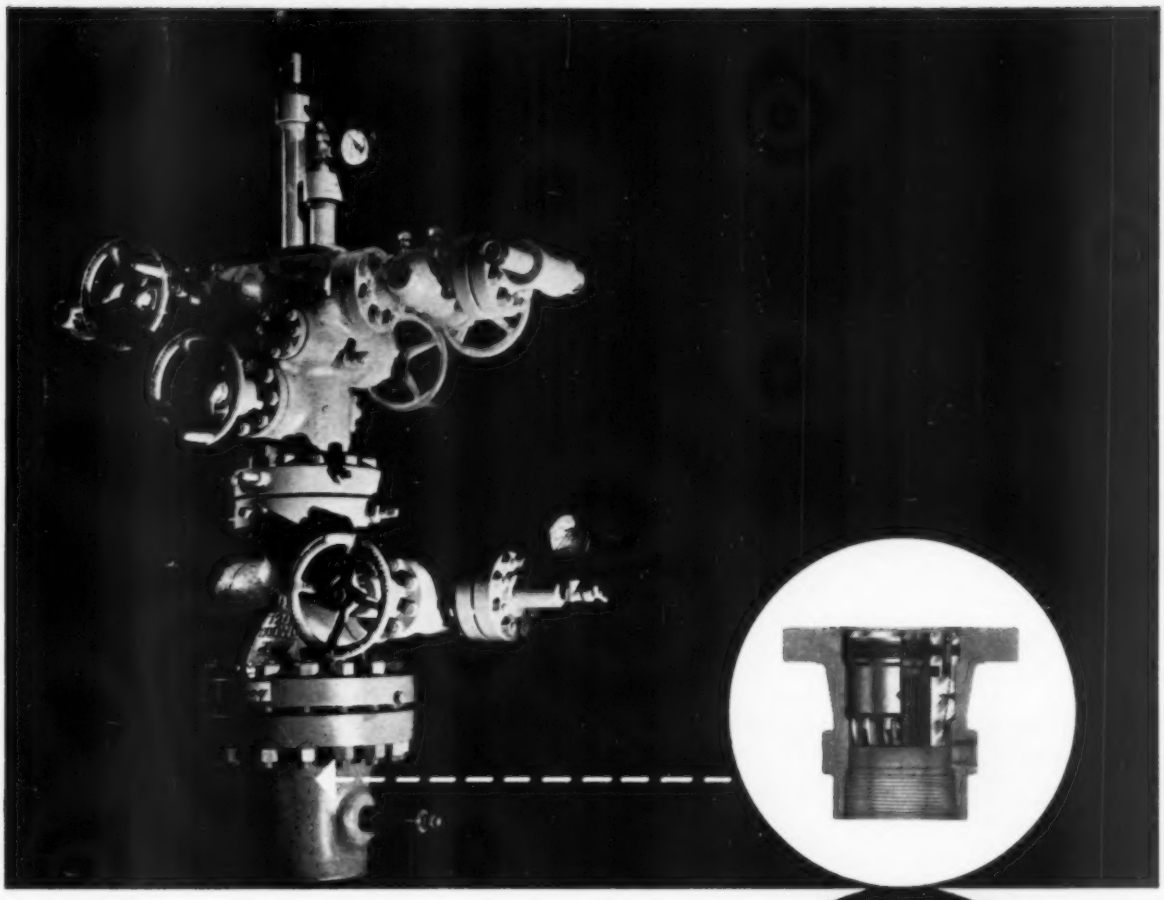

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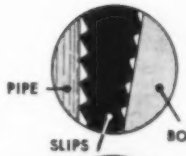
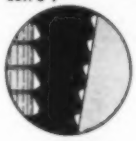


Before loading . . . interlocked slips are in position in hanger bowl. No hydraulic or mechanical pressures are effecting slip action.



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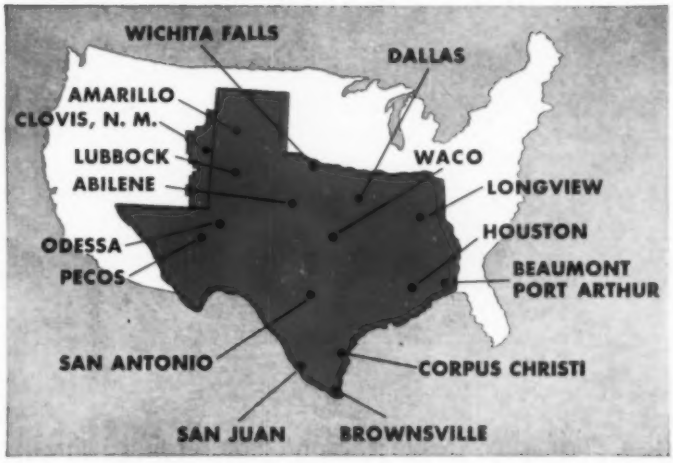

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DIESEL ENGINES

A well in operation in one of the projects of water injection of La Brea Pariñas in the desert area of Northern Peru. In the background is the high pressure pump house and injection pipelines.

Complex structural faulting complicates . . .

Sea Water Flood in Peru

Pacific Ocean provides abundant water for 15 integrated projects at La Brea Pariñas Estate in Northern Peru's desert region. Two-year-old flood now produces 2200 bbl daily — with production rising 60 bbl per day

W. E. Harris
and H. B. Zaremba
International Petroleum Company, Ltd.
Talara, Peru

AFTER two and a half years of developing water injection projects on its La Brea Pariñas Estate, International Petroleum Company now produces 2200 bbl per day of secondary oil which represents 8 percent of the estate's total production. Secondary oil by water injection has increased at a rate of 60 bbl per day per month and is expected to continue increasing as development progresses. Pacific Ocean water is supplied from a central station, that being the only source in this desert region.

Field Development

The company has been expanding its water injection program by developing about 700 acres annually. By the end of 1957, 3200 acres will be under flood in 15 projects. Seven of these are designed to maintain pressure and the remainder are in pressure-depleted sands.

Although gas has been injected for repressuring and pressure maintenance on this property for the past 30 years, water injection as a secondary method is relatively new. The present large scale operations, which began in 1955, followed a long, varied, and unimpressive history of pilot tests started after 1947. Several technical difficulties appeared during these tests and did much to discourage future water injection on a large scale. The first pilot failed, because of lack of floodable oil. Three other pilots had delayed response because of low input rates. Nevertheless,

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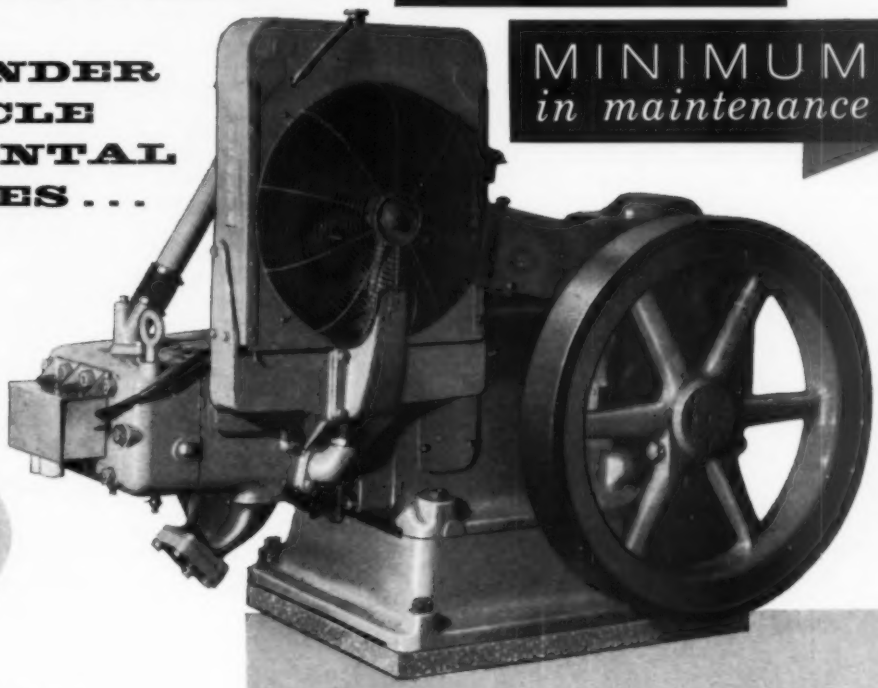

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2. **Lubricator automatically filled by filtered oil from crankcase.**
3. **Low tension ignition assures longer service life from magneto and spark plugs. (Optional).**
4. **Heavy duty long life spark plugs to reduce frequency of replacement or adjustment. (Optional).**
5. **Extended service clutch requiring greasing at long intervals. (Optional).**
6. **Prepacked fan hub assembly to provide servicing only at long intervals.**
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8. **Engines are provided with weather covers to protect all parts and allow engine to operate in the open without further protection.**

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four out of five tests were eventually successful; moreover, they proved that complicated fault structures could be flooded without adverse behavior. Experience gained from these early pilots, together with that from gas injection now serves as a basis for developing future projects.

The major problem in developing a project is the design of a pattern to obtain maximum sweep. This involves the proper location, completion, and operation of input wells and producers. The difficulty in such design arises from the complex structural geometry formed by a multitude of normal faults. Faulting separates the La Brea Pariñas oil field into numerous small reservoirs with areas averaging about 50 acres. In some exceptional instances, areas may reach 350 acres. Primary production declines rapidly, because these many, small reservoirs have limited volumes and lack active natural water drives. To maintain production, the company remains active in drilling, workovers, and secondary recovery.

Most of the production is obtained from five horizons of Paleocene and Eocene age. These horizons, which may be as thick as 3000 ft, consist of alternating sands and shales. The sand content may vary from 15 to 75 percent of the total thickness.

The sands are "dirty" and moderately friable. They consist of angular grains varying in size from silts to pebbles. Although individual sands within a producing section may contain permeabilities as high as several thousand millidarcies, the average for all sands does not exceed 1000 millidarcies, and is usually much lower. For a given horizon, which may vary in depth from the surface to 7900 ft over different parts of the estate, there is a marked decrease in permeability with increase in depth.

Recent investigations further reveal the existence of isolated reservoirs within a productive horizon. For example, where the shale content of the section approaches 50 percent, the sand members perform as individual reservoirs, having communication only at the wells. Erratic behavior resulting from input wells being completed in partial sections has actually occurred in several gas injection projects. Unless a sufficient number of inputs enountered full sections to counteract the effect of inputs completed in partial sections, an irregular sectional sweep occurs, possibly accompanied by a loss in production.

Location of fault boundaries and orientation of complicated fault blocks in advance of the initiation of a flood becomes increasingly difficult in sparsely drilled areas, particularly where thickness of the objective sand is diminishing. Where accurate geologic data is lacking for these or other reasons, input wells are drilled in a stepwise manner as the flood progresses.

At the present time, input patterns consist of line drives, five-spots, and inverted seven-spots. The choice of pattern is governed by economics, structure, and intake capacity. Six of the projects currently active are receiving water through wells located along the structural flanks, five are five-spot floods and one is an inverted seven-spot.

Because the formations are incompetent, all new secondary recovery wells have casing cemented against the section. All sands present at the input well are opened by gun perforation, with no attempt to selectively control migration of water at the point of injection. Selective control of water will be employed at the producer when necessary, thereby avoiding the hazard of erratic sweeps when such control is employed at the input well.

Channeling of gas in gas injection projects has been effectively controlled by use of packers. Because of the extensive shale barriers, benefits from packer settings are long lived. In a similar manner, the producing wells in water injection projects are gun perforated to permit packer settings, if necessary. To date, only one producer has required exclusion of water with a packer, and this job was fully successful.

Upon completion, input wells are backflowed or swabbed to clean the well bore. No additional treatment is given prior to injection. Then after injection begins, periodic injectivity tests are made on all input wells. Also, temperature surveys are run to check input profiles and locate any casing leaks.

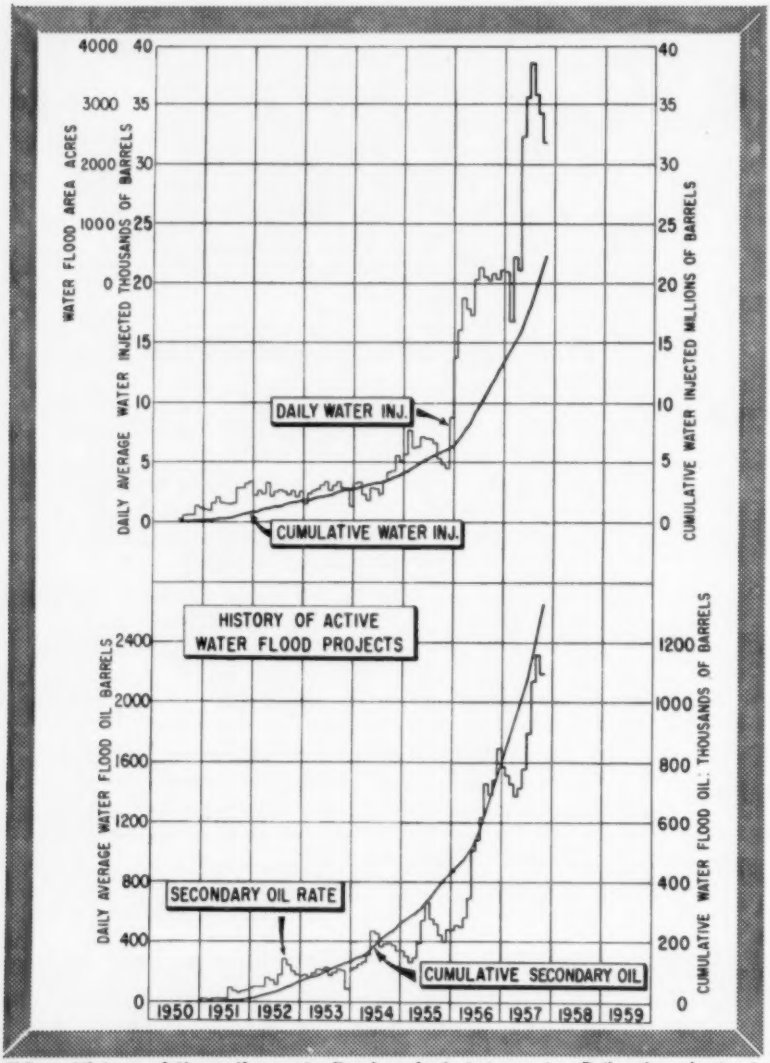
WATER FLOOD AREA ACRES
DAILY AVERAGE WATER INJECTED THOUSANDS OF BARRELS
CUMULATIVE WATER INJECTED MILLIONS OF BARRELS
DAILY WATER INJ.
CUMULATIVE WATER INJ.
HISTORY OF ACTIVE WATER FLOOD PROJECTS
DAILY AVERAGE WATER FLOOD OIL BARRELS
CUMULATIVE WATER FLOOD OIL: THOUSANDS OF BARRELS
SECONDARY OIL RATE
CUMULATIVE SECONDARY OIL
1950 1951 1952 1953 1954 1955 1956 1957 1958 1959

FIG. 1. History of the active waterflood projects is impressive. Daily oil production is 2200 bbl from secondary recovery. Cumulative secondary oil produced now totals more than 1,200,000 bbl.

LARKIN TUBING HEADS

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FOR DEPENDABILITY

The Larkin Type SR Tubing Head is a slip suspension head, equipped with a Neoprene Stripper which serves as a blow-out preventer and oil saver while tubing is being pulled or run. It is very suitable where higher pressures might be encountered.

FOR VERSATILITY

The Larkin Type R Tubing Head is a conversion from the Type SR Head. This ease of conversion makes it possible to use the same stripper adapter and Neoprene stripper when working on any well equipped with a Larkin Tubing Head.

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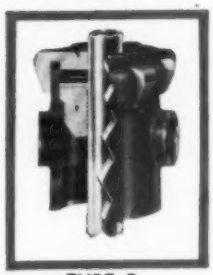
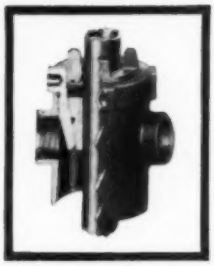


TYPE R



TYPE L

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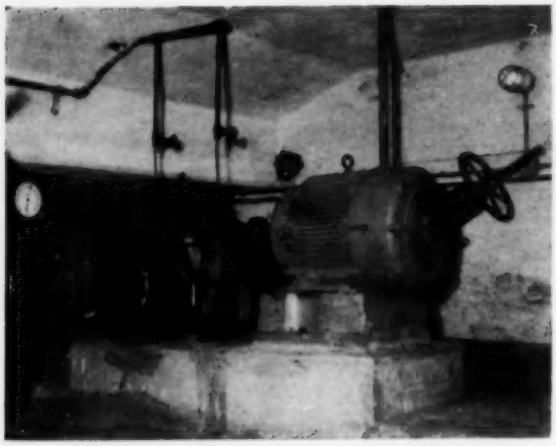

FIG. 2. **Raw sea water** is provided by this 2500 gpm capacity pump located on the lower deck of the cargo pier on Talara Bay.

FIG. 3. **Central treating plant** and booster station, as it existed before installation of vacuum deaerators.

Input pressures are limited to a maximum of 1.2 psi per foot of depth. Pressures in excess of this amount rupture the formation. Although "permanent" ruptures have developed around two inputs, they were successfully controlled with plugging agents and have required no further treatment.

Past remedial jobs to improve injectivity consisted of acidization and fracturing; however, neither treatment was entirely satisfactory. Even though fracturing has replaced acidization, troublesome inputs have not shown improvement after light water-fracturing treatments. Heavier treatments using nylon balls are now being evaluated.

On the other hand, fracturing of producers has boosted per well rates from an average of 30 bbl per day to 170 bbl per day without undue increases in water production, or subsequent rapid declines in oil production. Treatments given to producing wells are much heavier than those given to inputs.

An unusual feature of International's water flood program is the use of sea water for injection. Since the operation is located in the desert area of Northern Peru, the nearby Pacific Ocean provides the only adequate source of water. It's use, however, presents a number of handling and treating problems.

Gathering Sea Water

The first problem was the development of a satisfactory and economical method for withdrawing the water from the ocean. Initial methods included beach seepage pits, seepage wells and sea lines located as close as possible to the pools to be flooded. These methods proved to be troublesome and inflexible with respect to expansion of the supply facilities to handle additional projects. The widely scattered locations of the projects over the 30 mile coastal length of the property indicated that a single, central source of supply would be economically attractive.

The Talara Bay was chosen because of its central location and the availability of the necessary utilities. A loading and cargo pier provided a convenient site for the source pumps (Fig. 2) and electric power was readily available for the prime movers. These source pumps supply raw sea water to a centralized treating plant from which it is boosted to the high pressure field injection plants through a pipeline system (Fig. 3 and 4). The entire supply system is designed for step-wise expansion to a final capacity of 170,000 bbl per day. Present capacity is 50,000 bbl per day.

Injection Water Control

Water treatment and testing for corrosion control and removal of suspended solids and other formation plugging agents was the second problem. Early experience in handling raw sea water showed that mild steel is vigorously attacked by a pit-type corrosion action, resulting in complete penetration of supply lines in less than one year. Pumps and other equipment suffered similar attack, particularly when close to the supply source. The first type of treatment consisted of injecting combination organic corrosion inhibitors and bactericides, on the assumption that sulfate-reducing bacteria were the

THE AUTHORS

W. E. Harris, *chief reservoir engineer for International Petroleum Company, Ltd., at Talara, Peru, completed his education at The University of Texas in 1948 with a bachelor's degree in petroleum engineering. Following advanced study and teaching at The University of Texas, he joined International as a reservoir engineer in 1951. He became reservoir engineering supervisor in 1953 and held this position until 1956. He is presently in charge of all reservoir engineering activities for the company's operations in Northwest Peru.*

H. B. Zaremba *is equipment engineering supervisor for International Petroleum Company, Ltd., at Talara, Peru. A native of Evanston, Illinois, he enrolled at the University of Illinois in 1941, and received his degree in chemical engineering from Northwestern University in 1948. He joined International's staff as a petroleum engineer at Caracas, Venezuela, in 1948 and was transferred to Talara in 1951, where he worked in equipment and gasoline plant engineering. He became supervisor of the latter section in 1952. In 1953, he joined the product engineering department of Black, Sivalls and Bryson, Inc., at Oklahoma City as group head of the gasoline plant section. He rejoined International's petroleum engineering department early in 1956 in his present position and participated in the design of the water supply and injection facilities for the company's waterflood program.*

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THE EYES OF THE OIL INDUSTRY

SCHLUMBERGER

GEORGE GRIMMER, OTIS DESIGN ENGINEER, DISCUSSES THE NEW OTIS SLIDING SLEEVE

"Now a well can be set up with full-opening Otis side-door equipment"

Q. George, why is a full-opening tool desirable?

A. Well, with a sliding sleeve type side-door, the ports can be closed or opened, allowing a full opening for flow and wire line tools — with or without communication to the annulus.

Q. What are some of the major features of the Otis Sliding Sleeve?

A. For one thing, we can open or close all sleeves in the string with one trip of the shifting tool . . . or we can "selectively" shift a single sleeve. Also that there is no doubt that the sleeve shifts; the shifting tool will not pass through the sleeve — either up or down — until the sleeve *is* shifted. Another feature is that we can use the sleeve with Otis S Equipment.

Q. In other words, it broadens the use of the Type S Otis Landing Nipple?

A. Yes. Used with S Equipment, the sleeve can serve all of the purposes of a side-door choke. By itself, it can be used in single-string selective completions, to produce several zones selectively; as a circulating sleeve; as a well killer, and in permanent completions.

Q. Is the tool outsized — I mean large-diameter?

A. No indeed. It is collar-diameter, which is extremely desirable for parallel-string completions.

Q. I understand the Otis sleeve is pretty rugged.

A. It's a lot more than it needs to be. On test, we put a strain on it equal to twice the yield strength of N-80 tubing and the sleeve shifted O.K. We use a non-vulcanizing, non-swelling V-type packing, too.

Q. What about equalizing pressure differentials as the sleeve is shifted?

A. The tool has equalizing ports as well as flow ports. It is easily equalized, which prevents damage to the packing, even with high differentials. Incidentally, we have 1¼ square inches of flow area through the ports . . . considerably larger than the area in a choke.

Q. George, will this equipment replace the Otis Side-Door Choke we've used for so many years?

A. Not entirely; the Sliding Sleeve will have certain advantages in some wells, and vice versa for the Removable Side-Door Choke. I would suggest that operators check with one of our many branch offices for a competent recommendation.

Otis — first in Pressure Control

OTIS Engineering CORPORATION

Branches Throughout the Oil Country

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FIG. 4. **Pacific Ocean water** pumped from Talara gets an added boost by 1500 gpm capacity treated water pumps such as these.

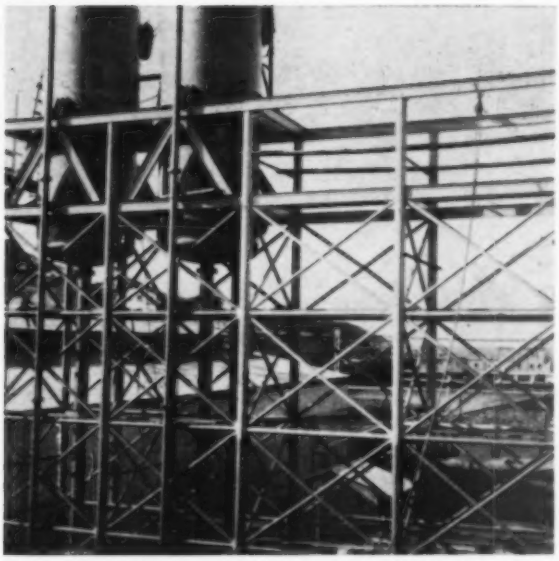


FIG. 5. **Two 1250 gpm capacity vacuum deaerators** for removal of dissolved oxygen from sea water in construction at central treating plant.

principle cause of corrosion. Later quantitative studies, however, showed these inhibitors to be generally ineffective in either killing bacteria or reducing the corrosion rate. These abundant organisms are not now considered a serious corrosion problem although their multiplication and life processes in the formation surrounding the injection wells could cause plugging, of which there is some definite evidence. Presence of hydrogen sulfide in the produced water from waterflood pools supports this theory. Quantitative evaluation of commercial bactericides is in progress to determine the most effective and economical treatment.

After further study, the dissolved oxygen content of the raw water was identified as the principal cause of the severe corrosion. The sea water is essentially saturated with oxygen which, at prevailing water temperatures, ranges from 6 to 8 parts per million. The pH averages neutral to slightly basic. Oxygen is now being removed chemically by injection of sodium sulfite solution. Corrosion coupon test data and frequency of corrosion failures show that oxygen removal has greatly reduced the corrosion rate. Equipment for mechanical removal of oxygen is now under construction to reduce the high cost of sulfite treatment: Packed vacuum deaeration towers will be installed for this purpose (Fig. 5).

Filtration of suspended solids from the water is accomplished at the high pressure injection plants by graded bed and permeable plate type pressure filters. With adequate corrosion control future plans include centralization of all filtering at the Talara treating and supply plant. High capacity, automatically self-cleaning type filters will be used.

Another bothersome suspended solids problem is the presence of varying quantities of fine sand in the raw water. This material imposed heavy loads on filtering equipment and also caused abrasion damage to mechanical equipment. Fine sand removal, up to a 100 micron separation, is accomplished at the source by liquid cyclones (Fig. 6). This is a water clarification device developed and widely used in the mining industry. The degree of sand separation is determined by the inlet rate, geometric design of the unit and rate of bottom draw-off.

The ten high pressure injection plants now in operation are equipped with triplex injection pumps, pressure filters, surge tanks and semi-automatic controls. The latest design emphasizes streamlined piping to reduce pulsation and includes slow-speed horizontal triplex pumps (Fig. 7). ★ ★ ★

FIG. 6. **Liquid cyclones** for removal of fine sand from raw supply water.

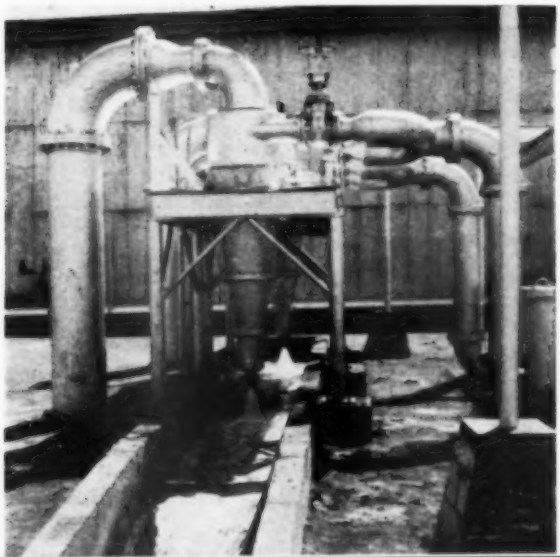
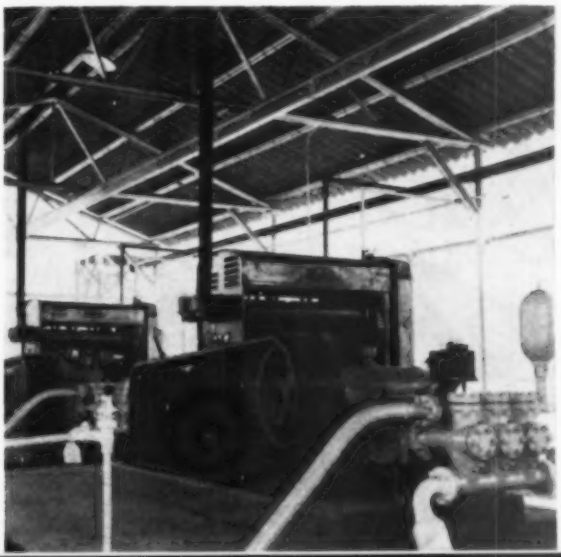
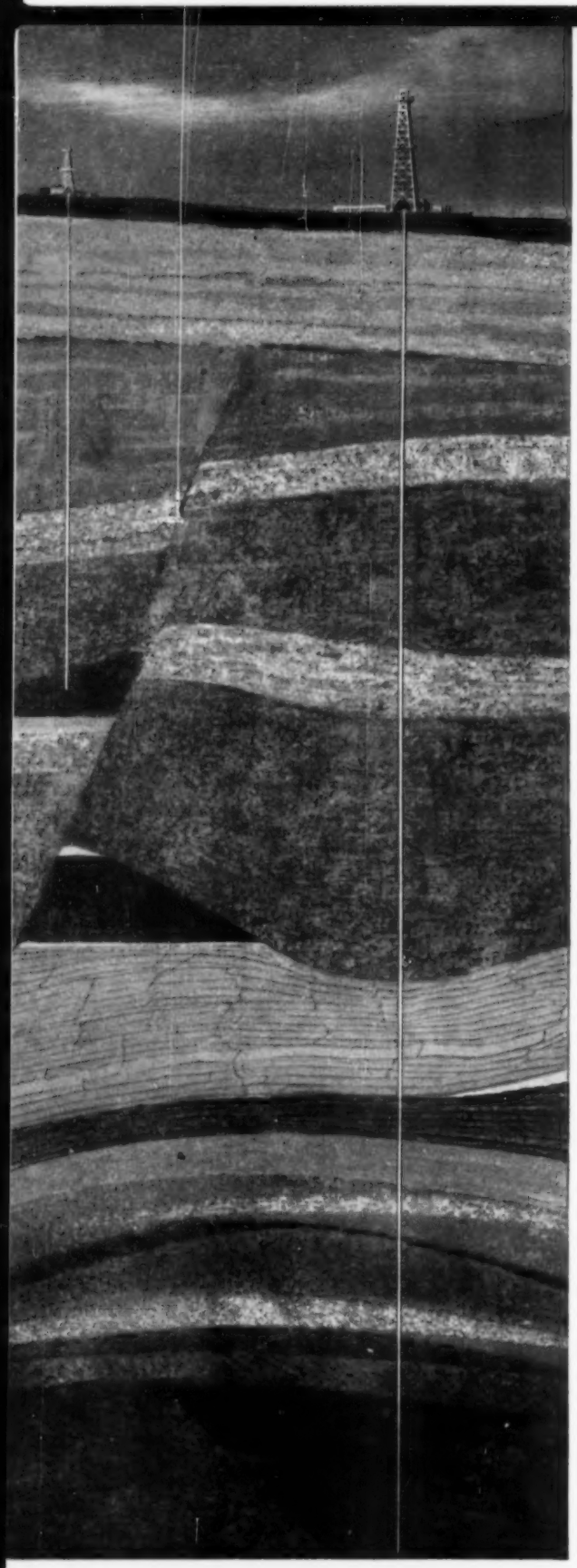


FIG. 7. **Horizontal triplex pumps** are used in this typical high pressure water injection plant.





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But what is the limit? How much stress can be withstood?

One of the answers to this problem of stress, particularly to casing, is National Tube's *Deep-Well* Casing. *Deep-Well* Casing possesses exceptional physical characteristics. It is tough, strong and has good yield strength. Minimum yield strength is 110,000 psi at .6% total strain, and average ultimate strength is 139,000 psi. And perforating tests made on National *Deep-Well* Casing have been excellent. The next time you need high strength, high collapse resistance and maximum security in a casing, use National *Deep-Well* Casing. You can rely on it to do the best job possible.

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National Warm-Worked Casing—Grade N-80. An extremely high-strength casing possessing a uniformity of physical properties which give it high collapse resistance and greatly increased joint strength. It is hydrostatically tested to 80% of minimum yield strength up to a maximum of 10,000 psi.

National Deep-Well Casing. The strongest casing produced under A.P.I. specifications, to meet constantly increasing depths. Due to the severe service for which it is intended, it is hydrostatically tested to 80% minimum yield strength up to a maximum of 12,000 psi.

National (B) *Buttress-Thread.* Developed to satisfy the need for a casing joint which will safely and economically support the weight of deep-well casing. The buttress-thread joint is comparable in strength to that of the body of the pipe itself.

• • •

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Ask for Bulletin No. 15.

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C. N. Griffis
Publisher, Peruvian Times
Lima, Peru

Area of Promise

First South American country to produce oil in commercial quantities, Peru has no sensational discoveries. Hope lies in eastern jungles for larger fields

PERU'S production edges UP

ALTHOUGH PERU was the first country in South America to produce oil in commercial quantities, development over nearly a century has been slow and unmarked by sensational discoveries. Most of the production comes from International Petroleum Company, Lobitos and Empresa Petrolea Fiscal in the Northwest Coastal area. From the early beginning of commercial operations in 1870's to the first of 1958 about 520 million bbl have been extracted. The small production of Petrolera Peruana comes from an area adjacent to the southern boundary of the International Petroleum concession and that of Douglas Oil Company from the continental shelf extension of the Lobitos concession.

Ganso Azul (Blue Goose), the only oil field in commercial production in the Oriente or Eastern Peru, began production in the 1940's. It is on the Pachitea near the point where this river joins the Urubamba to form the Ucayali.

One hundred miles north of Ganso Azul field, on the Ucayali near Contamana, a second field has been developed by Cia. Peruana de Petroleo "El Oriente" S. A., a Peruvian company now operating in cooperation with a German Group. Consolidation of this development and the marketing of production will be delayed until at least 1959.

So far exploration in other parts of Peru has drawn a blank, with the exception of a small development in the Andes near Lake Titicaca, at an elevation of around 12,000 ft, where an American company is reported to have extracted some 285,000 bbl of oil in 1906-1915. This so-called Pirin field was then abandoned and several successive attempts since to find commercial oil in the area have ended in failure.

First Oil Field

The first modern exploration for petroleum was undertaken by Diego de Lama, a large land holder in northwestern Peru in the early 60's of the last century. He explored the region known as Zorritos, in the area now controlled by the Empresa Petrolera Fiscal (government company), and presumably in connection with these explorations the first successful oil well is reported to have been drilled in the area in 1863.

Production in the Zorritos fields has been steadily declining. Installations and rights of the Zorritos company were acquired by the government and this area is now incorporated in the so-called national reserve held by the Empresa Petrolera Fiscal, comprising all territory north of the International and Lobitos fields, to the Ecuadorean frontier.

Special contracts for exploration and exploitation of a portion of the EPF holdings have been entered into with: Peruvian Pacific Petroleum Company controlled by Cities Service, 121,000 hectares; and Petrolera Amotape, S.A., a Peruvian-American concern, 16,058 hectares. Production figures for these two companies are included in the EPF returns.

IPC-Lobitos Contract

Most important development in the northwestern oil fields of Peru during the past year was the official announcement made March 8, 1957, by IPC and Compañia Petrolera Lobitos, owned by Lobitos Oilfields, Ltd., London, that IPC had acquired 50 percent of the shares and rights of the Peruvian subsidiary of the British company.

Amount paid Lobitos by IPC was $18,000,000, according to press reports and IPC undertook to invest $40,000,000 in the joint development of the Lobitos concession from date of the agreement to December 31, 1961. Of the $18,000,000 received by Lobitos Oilfields, $8,000,000 was to be paid to Cia. Petrolera Lobitos for the joint development of the concession.

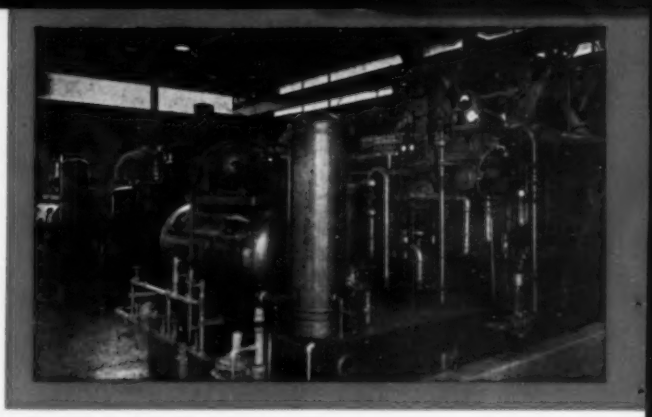
The excerpt below made by IPC and Lobitos in Lima will serve to explain the agreement as well as presenting an authoritative opinion on the present status and future prospects of the industry in Peru.

In the Sechura Desert, south of IPC and Lobitos holdings on the Pacific Coast, more than 1½ million hectares of oil claims were filed following the opening of this area in 1953. All of these claims have since been abandoned with the exception of less than 120,000 hectares.

Only production obtained has been from the small 8000-hectare holding of Petrolera Peruana, S.A. Drilling in the Ica-Pisco coastal area south of Lima was also abandoned after a dry well was sunk to 3126 ft in 1955.

Petroleum possibilities of Peru are set forth lucidly in this IPC-Lobitos statement:

"As is of public knowledge, the work carried out in the exploration for pe-



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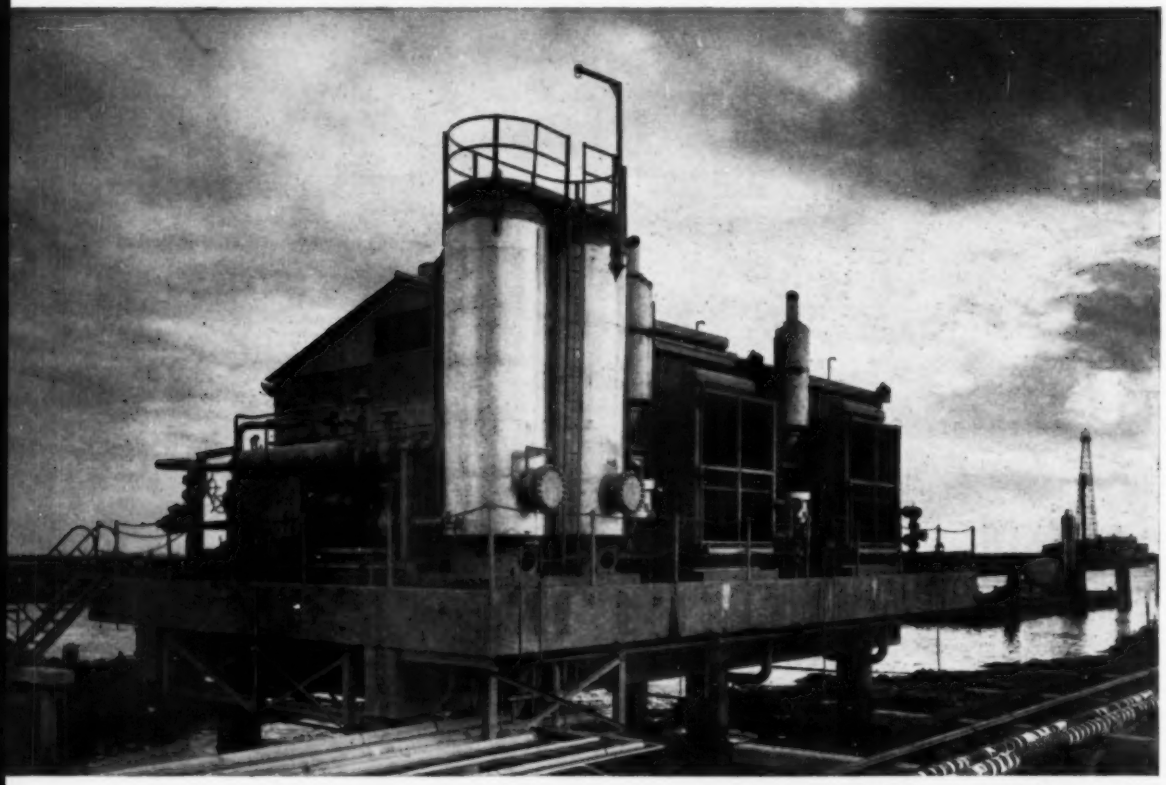

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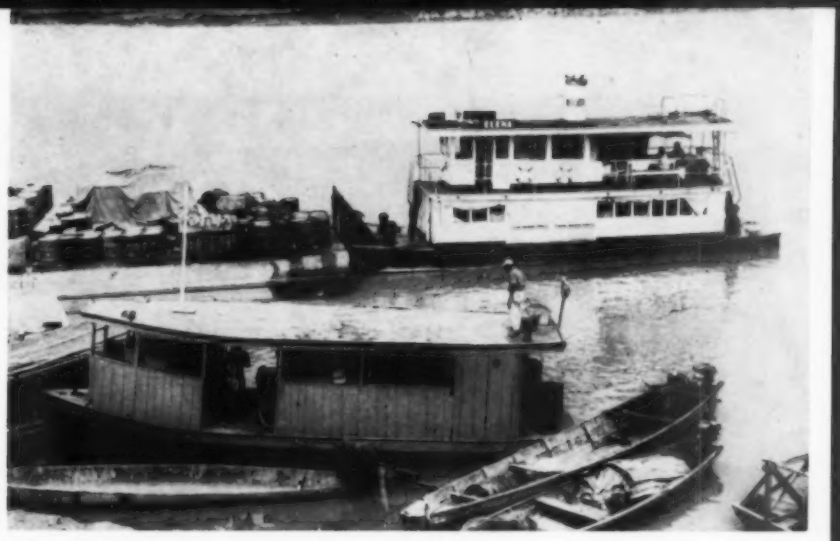
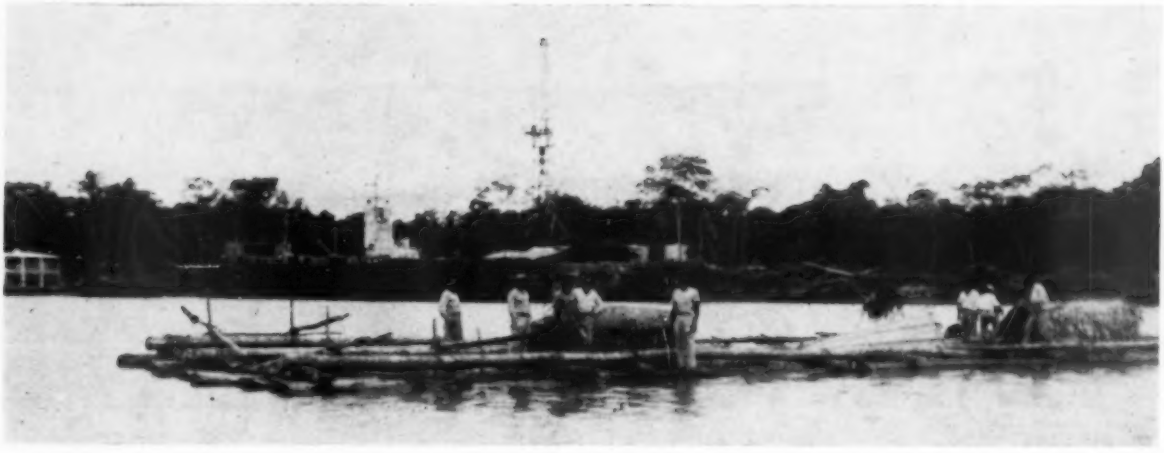


Port of Pucallpa on the Ucayali River, showing one of the smaller tugs of the Ganso Azul Oil Company with a barge of oil drums.

The first of three dry wildcats drilled by Texas Petroleum on the Marañon River. This well reached a depth of 9877 ft. All three were on the Marañon and total cost of the tests was more than one-half million dollars.



troleum in the Sechura Desert and in Ica has been unproductive. On the other hand, possibility that petroleum, which may be found in the Montaña or Eastern Region of Peru, may be used in the industrial centers of the Coast and the Sierra is still very remote. Exploration and exploitation of petroleum of the Montaña is an economic and technical undertaking of colossal proportions.

"Construction of a pipeline alone, which starting from the heart of the forest region and crossing the Cordillera of the Andes would convey the petroleum of the Montaña to a Pacific port, would represent the investment of many thousands of millions of soles.* Even if petroleum were found in Eastern Peru under the most favorable circumstances, for technical and geographical reasons it would require many years of work before this production could be used commercially on the coast and in the Sierra of Peru."

"To Meet Growing Demand"

"Therefore, as there are no new oil fields in the country capable of producing a large volume of oil within reasonable time, the petroleum industry is faced with the problem of how to meet the growing demand for petroleum products in the national market.

"Owing to the period of flourishing industrial development which the country is now enjoying, there has been noted in recent years a steady increase in the volume of petroleum products required for the Peruvian domestic market. Unfortunately, production in the oil fields of La Brea y Pariñas of International Petroleum is declining after long years of uninterrupted exploitation. The only hope of compensating in part for this gradual exhaustion lies in the application of costly and modern procedures of secondary recovery, which are now being employed."

Accuracy of the IPC-Lobitos comment that "exploration and exploitation of petroleum of the Montaña is an economic and technical undertaking of colossal proportions" has not been challenged in Peru. Though it required vigorous political action and determined executive pressure to secure congressional approval of the new petroleum law promulgated by the government on March 12, 1952, former opponents of this legislation which turned the development of the national petroleum resources over to private enterprise are now conspicuous by their silence.

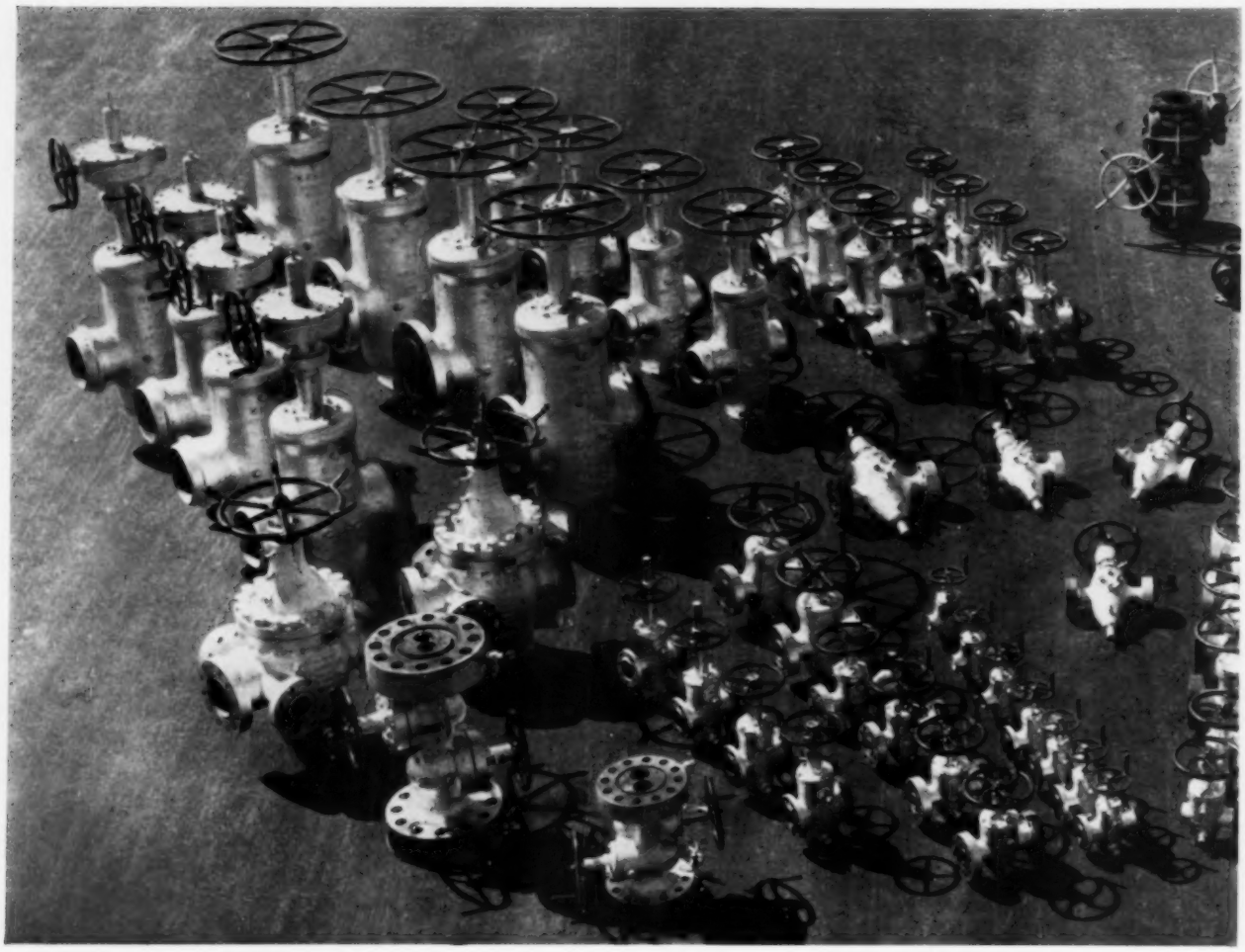
Laws Encourage Search

It is now recognized by the proponents of the policy of state control of oil development, now in effect in countries such as Brazil, Argentina, and Chile, that had this policy been followed in Peru it would have involved the government in a formidable disbursement of public funds — probably $30,000,000 to $40,000,000 — without tangible result, or probably would have delayed the practical inventory of Peruvian oil resources, now being carried out by private capital, for another generation or so.

Is Oil in the East?

"Will a major oil field be found in Eastern Peru?" is a common enough

*1 sole = 5 cents.



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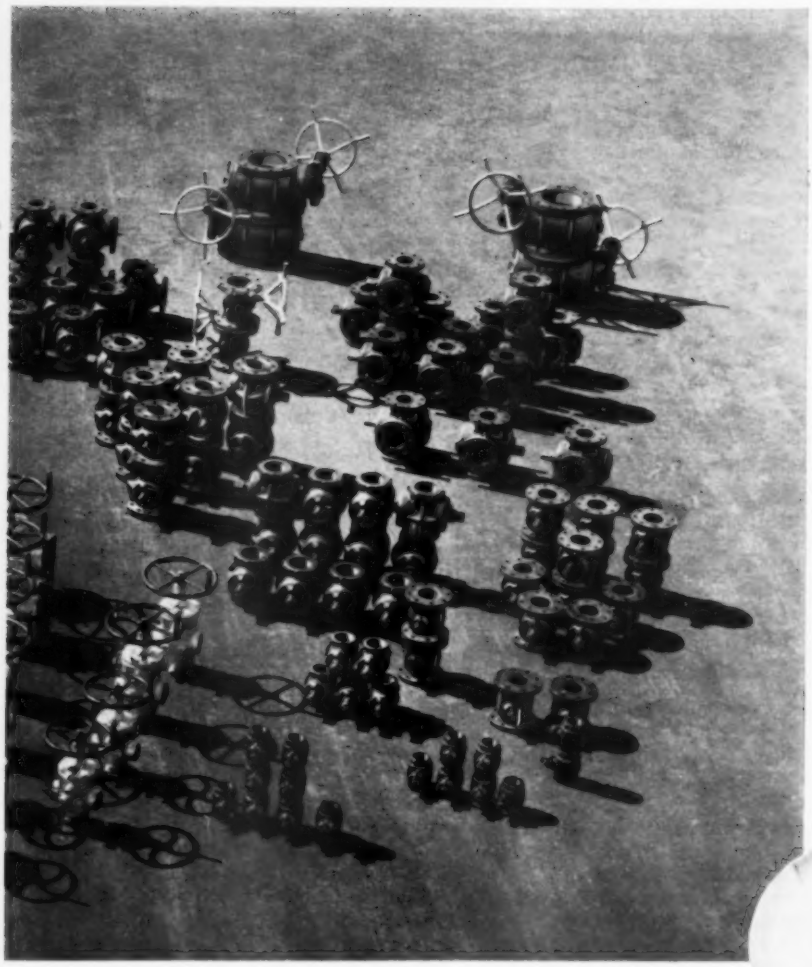

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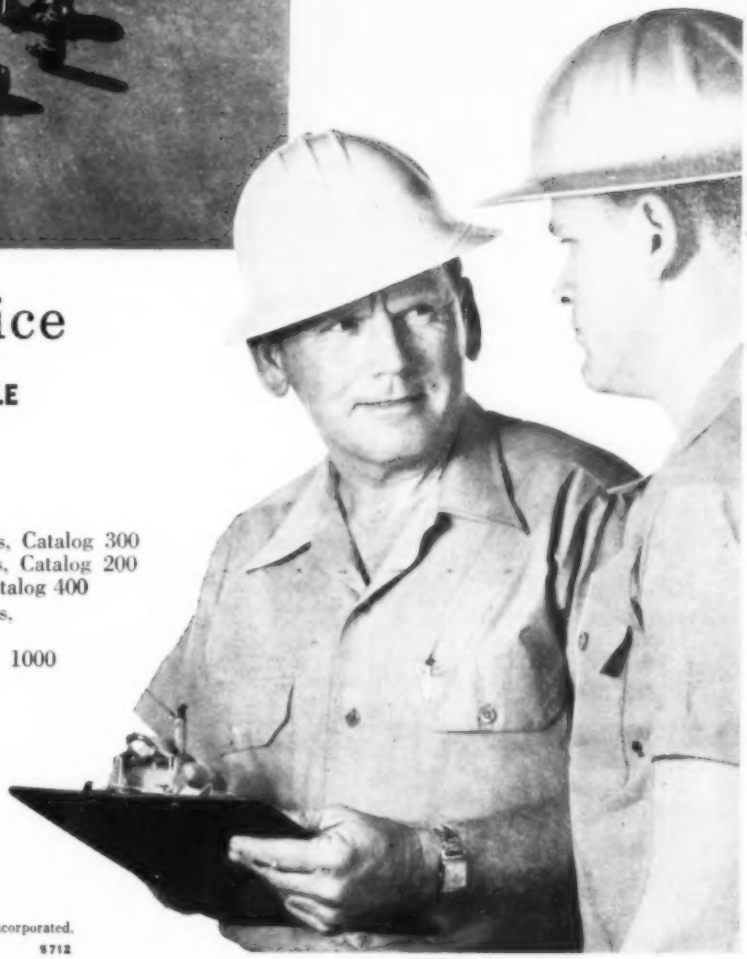

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102

question in Lima conversation. It ranks with such questions as "What number will win the lottery?" and "Will there be an earthquake?" The answer of the experts is either a quizzical smile or a shrug of the shoulders. Yet the "undertaking of colossal proportions" is underway throughout the Amazonian lowlands of Peru — by foot trail, mule trail, canoe, launch, steamer, houseboat, and plane.* The only essential vehicle lacking appears to be a helicopter.

During 1955 and 1956 Fairchild Aerial Surveys, Inc., in cooperation with the National Aerial Photographic Service (known as SAN from the Spanish initials of its name) of the Peruvian Air Force, carried out aerial photographic and magnetometer surveys covering virtually all of the more than 13,000,000 hectares comprising the present concessionary area in Eastern Peru.

Much of the photographic work and all of the magnetometer work was done by Fairchild, while the photographic mosaic work was carried out by SAN. During 1957 a series of additional aerial photographic contracts were carried out by SAN. Results of these surveys are available to interested parties on the payment of reasonable fees and, of course, to the government for official use.

The work has constituted an International Geophysical Year in miniature for Peru and when finally digested by the map makers should make available for the first time, more than 400 years after the first discoveries, an accurate map of the Peruvian Amazon region.

In the field of seismograph surveys the most extensive work in Peru has been carried out by Geophysical Service, Inc., of Dallas, Texas. From December 1954 to April 1955 a survey was carried out for Texas Petroleum on the Marañon River. Following this survey three wildcats were drilled by Texas, between June 1955 and February 1957. All were dry.

Texas' fourth wildcat will be drilled in cooperation with the recently formed Petrolera Yurimaguas, S.A., (not listed in the concession table). Held two-thirds by Texas and one-third by Petrolera Yurimaguas, the latter concern is taking over 488,789 hectares of exploration concessions previously held by "El Oriente."

During 1957 and continuing through the current year, GSI has been carrying out the first land seismic surveys in Eastern Peru. Work has been done in the Contamana area for "El Oriente" and in the Pucallpa area for Peruvian Oils and Minerals "El Oriente" and Mobil Oil del Peru. At present a seismic survey of the Aguaytia River, which enters the Ucayali from the west below Pucallpa, is being carried out by GSI for the above three concerns, and an exclusive contract for more extensive work in this general area has been signed with Mobil.

Reports received in Lima recently indicated that "El Oriente" had struck oil-bearing sands with their sixth well, Maquia No. 6, on their "El Son" concession, near Contamana. Confirmation of the value of this find is still lacking. This is the area being developed with the West German Group — Deutsche Erdoel, Wintershall and Elwerath — on a 50-50 basis.

"El Oriente" has brought in three producing wells on this concession, all of them with a production of approximately 500 bbl a day each. The first well, Maquia No. 1, brought in March 10, 1957, was the first successful oil well in Eastern Peru since the discovery of the Ganso Azul field. Ganso Azul and the Maquia discoveries are two tentative affirmatives to the questions of whether Eastern Peru will have enough oil production to pay for a pipeline to the coast. ★ ★ ★

*See table on "Petroleum Concessions," in "Peru Prepares for the Future" beginning on page A-21.

Petroleum Production in Peru.

By Company.	1957	1956
International Pet. Co.	12,867,710	11,557,144
Cia. Petrolera Lobitos	4,343,603	5,417,649
Empresa Petrolera Fiscal	1,059,894	797,689
"Ganso Azul"	780,330	402,807
Petrolera Peruana	153,137	187,716
Douglas Oil of Calif.	16,388	20,732
	19,221,062	18,383,737

Peruvian oil production by years.

Average	Bbl	Year	Bbl
1880-89	12,000	1950	15,028,000
1890-99	115,000	1951	16,110,000
1900-09	546,000	1952	16,403,000
1910-19	2,141,000	1953	15,999,000
1920-29	8,091,000	1954	17,161,000
1930-39	14,345,000	1955	17,244,000
1940-49	13,458,000	1956	18,384,000
		1957	19,221,000

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A standard UNIBOLT Adjustable Wing Valve, installed on a corrosive well in the Katy Field (Texas Gulf Coast) required replacement of the carbon steel seat in only 45 days. A UNIBOLT "SA" Stainless Valve installed at that time has shown no corrosion damage in eight years. As the above photograph reveals, the 8-year-old stem seat (right) still shows no sign of corrosion, for all practical purposes is as good as the new stem seat (left).

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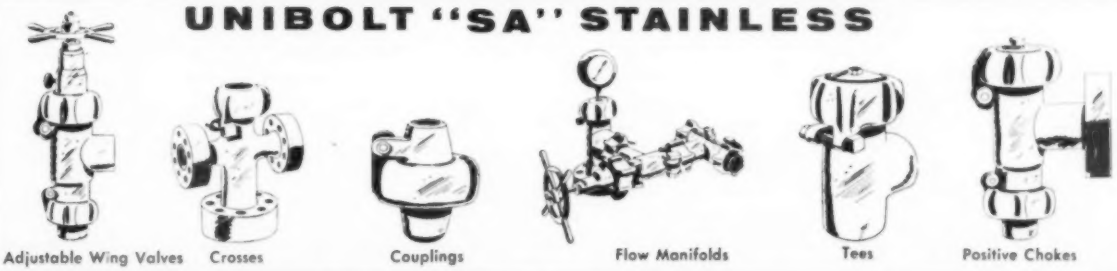

P 640.151
P 420.112.51

Simplified gamma-ray technique used in

LPG-STORAGE WELL LOGGING

Inexpensive instrument yields accurate LPG-salt water interface, promises to be multi-purpose tool for routine use at storage site

Robert F. Sippel and H. Darwin Hodges
Magnolia Petroleum Company
Field Research Laboratory
Dallas, Texas

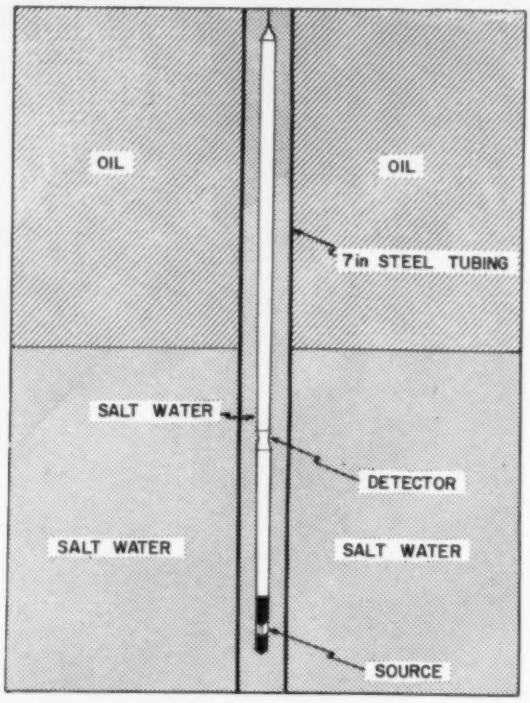

FIG. 1. **Storage well logging instrument,** although arranged similar to that used in exploration well logging for determining density of formations, design parameters are considerably different. Tool diameter is two inches. Source and detector are spaced 24-in. apart. No current of any kind is sent down the cable, since the instrument is driven by batteries contained in the down-hole probe.

A SIMPLE GAMMA-RAY LOGging tool has been devised to locate the LPG-salt water interface in LPG salt dome storage wells. Laboratory and field experiments with the tool indicate accuracy within one or two feet.

Tool cost and operation expense is relatively cheap, permitting use of the instrument routinely at the storage site. Value of the tool, however, does not stop with interface delineation; it is being found useful in locating extent of narrow necks in the underground cavern, locating position of the casing shoe and tubing collars. It may also be used to obtain the cross-sectional area of the storage cavern as a function of depth.

Value of Interface Delineation

In LPG salt dome storage wells it is important to keep track of the LPG-salt water interface. At all times it is important not to deplete the wells so far that the interface reaches the casing shoe, since the salt water in contact with the casing seat could leach the seal and result in well leakage. In addition, knowledge of the interface position is most helpful in filling operations and in routine operation of the well.

Material balance calculations can of course be used to track the interface. However, with the material balance method, errors are cumulative; after a period of months in which fuels have been pumped in and out of the well, one no longer has confidence in his knowledge of the position of the interface.

Since an LPG salt dome storage well is actually an enormous manometer, the interface could be located by a manometric calculation. In practice, to locate the interface to the desired accuracy, it is necessary to know well temperature as a function of depth and also to measure pressures with extreme accuracy. Since in such a large cavity several months are often required to reach temperature equilibrium, this method is not a practical one.

In the absence of an adequate method, a need has existed for a simple logging tool which will locate the interface within a few feet. Laboratory and field experiments indicate that a simple gamma-ray unit can fulfill these requirements.

Tool Description

The instrument used in these experiments is shown schematically in Fig. 1. The essential features are a source of gamma-rays, in this case 6 mc of cobalt-60, and a detector separated from the source and shielded therefrom with lead absorber. The arrangement is similar to that used in exploration well logging for determining density of formations traversed by the bore hole.[1] In the storage well logging instrument, design parameters are considerably different, because of the special conditions encountered. In all such instruments only gamma-ray photons which have been scattered at least once can reach the detector.

For the light elements, with the exception of hydrogen, the probability of gamma-ray scattering is proportional to the density of the scattering material. Thus, the counting rate of the detector is sensitive to the density of the material surrounding the borehole. As the density increases from zero, the counting rate increases from zero as scattering in the formation increases. As density increases further, the scattering increases to the point where the gamma-rays are so degraded in energy that photoelectric capture prevents their reaching the detector. Thus, counting rate increases from zero density, reaches a maximum and then decreases upon further increase in density. For the present tool, counting rate decreases with increasing density of the surrounding material.

Since in the storage well case the hole is smooth bore and backed up by homogeneous non-radioactive mater-

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ials, it is possible to obtain good results with a small diameter tool. Diameter of the tool used in these experiments was two inches. Source and detector were spaced 24-in. apart. The probe was a modification of a conventional natural gamma-ray logging tool.

The detector in this tool is a 1 by 1½-in. sodium iodide crystal coupled to a 1½-in. diameter photomultiplier tube. Detector pulses drive a univibrator, which in turn produces pulses whose length may be adjusted as desired by changing a coupling condenser. Output pulses from the univibrator are fed directly into the cable. No attempt is made to preserve the pulse shape during transmission to the surface. In fact, the cable itself causes considerable integration on "smearing" of these pulses during transmission to the surface. At the surface additional integration is applied, yielding a d-c voltage. This d-c voltage, proportional in magnitude to the number of photons entering the detector, is applied directly to a strip chart recorder. No current of any kind is sent down the cable.

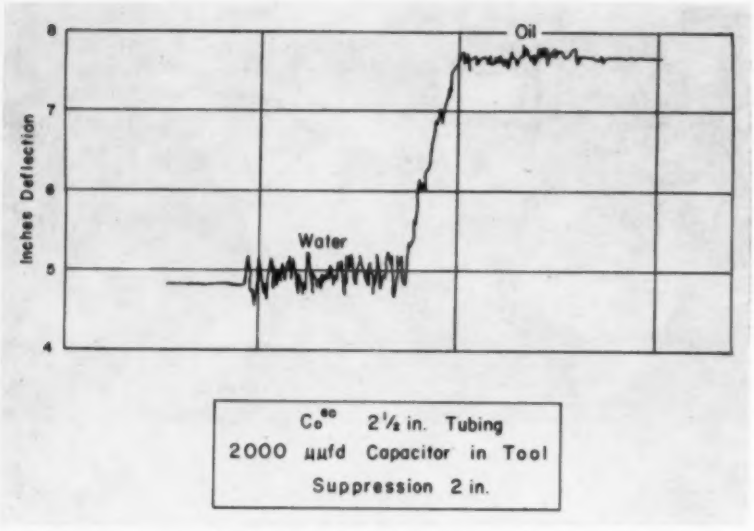

FIG. 2. **Test results** are shown on these psuedo-logs. Adequate break at the oil-water interface is obtained. This log was taken in 2½-in. tubing. Source-detector spacing was 25-in.

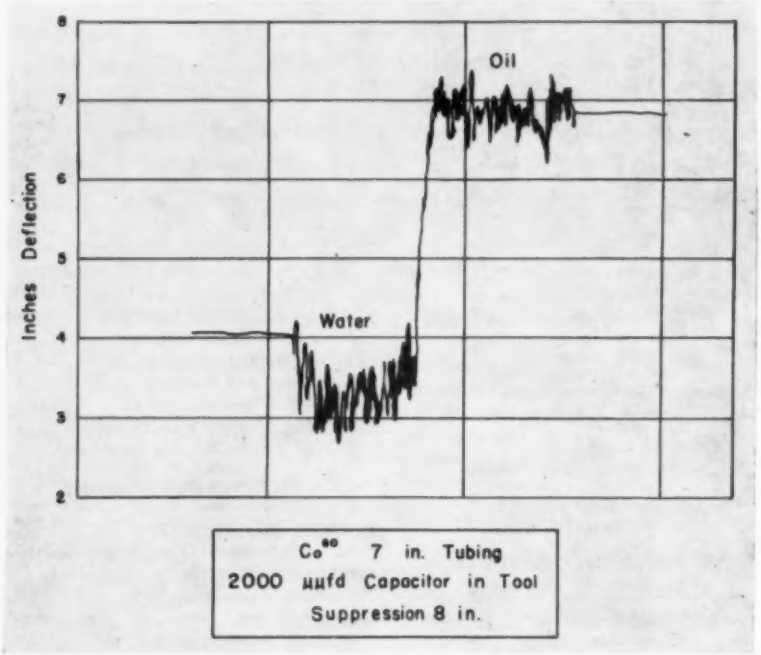

FIG. 3. **Log of lab test was taken in 7-in. tubing.** For lab test work a recording potentiometer of 100 mv was used.

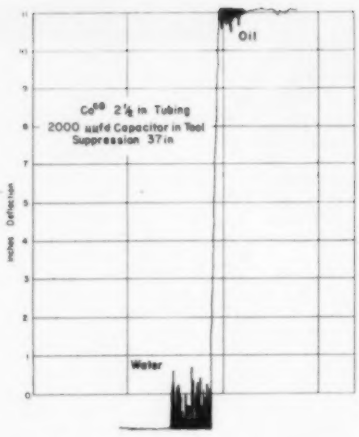

FIG. 4. **Lab test log** here illustrates maximum break presently obtainable, although no more information is obtained than in Fig. 3. As the absolute value of the break increases, the statistical uncertainty increases in the same proportion. This test was conducted in 2½-in. tubing.

The entire instrument is driven by batteries contained in the down-hole probe. Integral bias is afforded by the univibrator circuit which can be set to trigger on pulses greater than any predetermined value.

Lab Results

A mock-up of an LPG storage well was built to test the tool at the laboratory. This consisted of a three-foot diameter barrel six feet high. Tubings of various sizes could be mounted coaxially within the barrel. The inner tubing was filled with salt water; the outer barrel was filled halfway with salt water of density 1.15 grams per cu cm. The upper three feet of the barrel was filled with Sovasol-5, a light petroleum fraction. No attempt was made to perform continuous logs in this system.

To test the effect of different source-detector spacings and of different tubing diameters, the tool was first lowered in to the salt water and the recorder run on time drive. The tool was then raised until the source and detector were in the oil and again the recorder run on time drive. The resulting psuedo-log gives a good indication of the counting rate change to be expected at an LPG-salt water interface, and also a measure of the statistical uncertainty.

Fig. 2, 3, and 4 give typical results obtained with this mock-up. It may be seen that an adequate break at the oil-water interface is obtained with the 2-in. tool for all tubing sizes between 2½ and 7-in.

Fig. 4 illustrates the maximum break obtainable with the present arrangement. Although the overall break is very impressive, no more information

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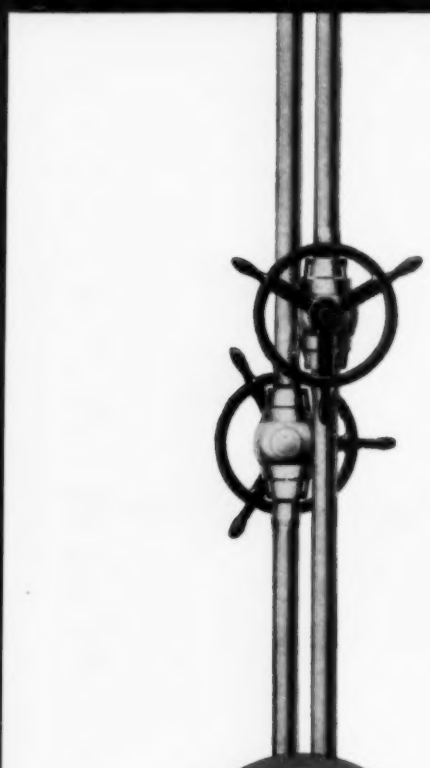

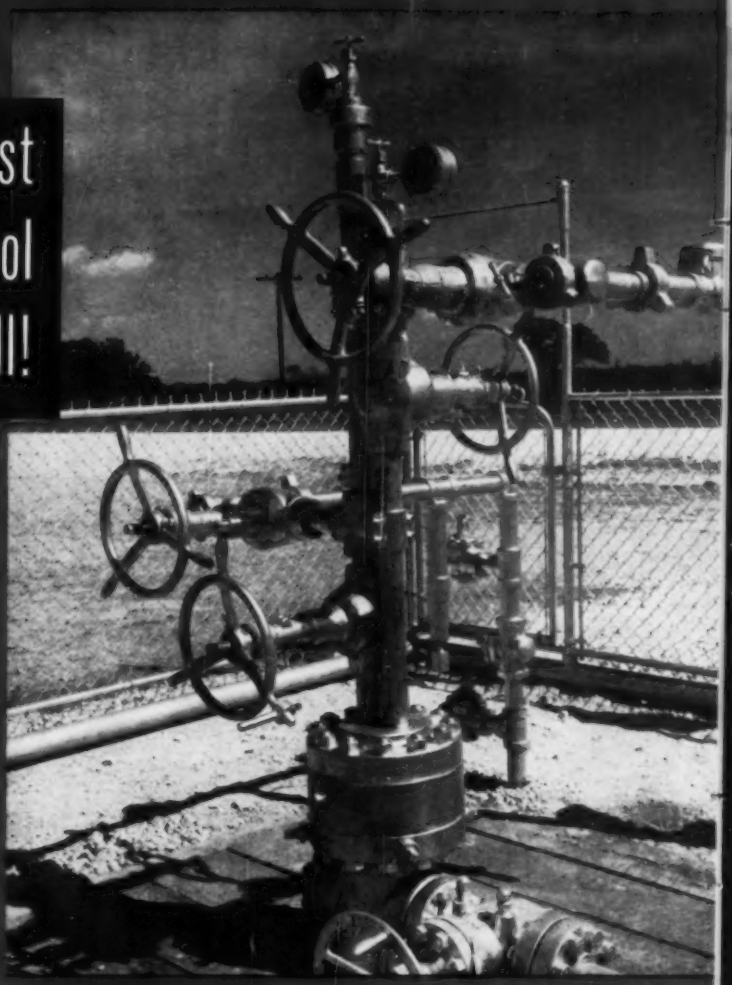

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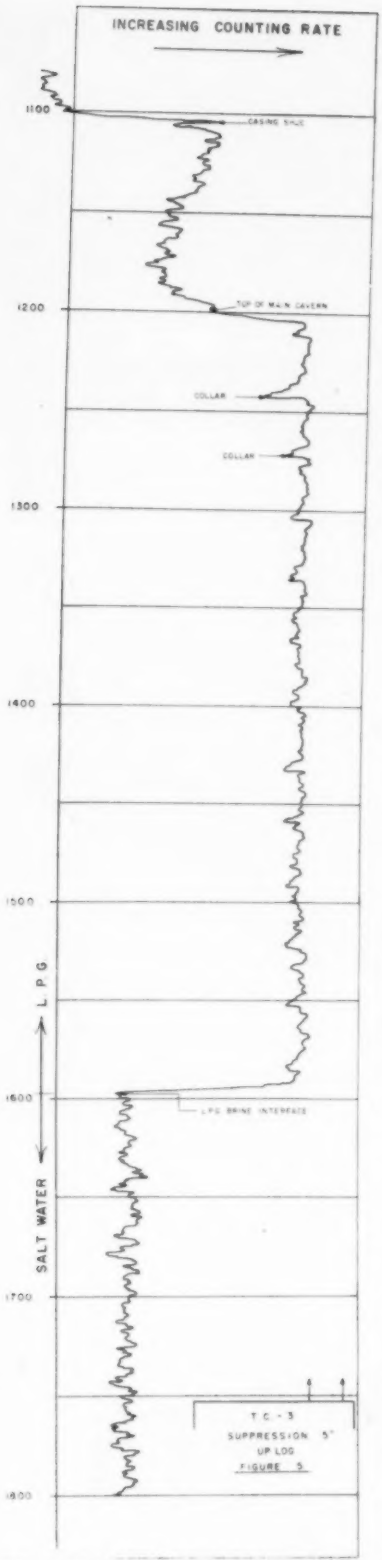

FIG. 5. **Field test of the tool** in storage wells at Hull, Texas, resulted in this log, taken in Magnolia's LPG Storage Well No. 2. Note other bottom-hole information given other than interface delineation. All field tests were successful.

is obtained from Fig. 4 than could be obtained from Fig. 3. As the absolute value of the break increases, the statistical uncertainty increases in the same proportion.

The data in all three of these figures were obtained with a source-detector spacing of 25 in. For this work a recording potentiometer of 100 mv sensitivity was used. The 2000 $\mu\mu$f (micromicrofarads) capacitor refers to the coupling capacitor in the univibrator circuit. Two-thousand $\mu\mu$f yielded a pulse length of approximately one millisecond.

Selection of the proper univibrator pulse length is important, since it imposes a dead time of this amount on the system. Too long a pulse length causes excessive dead time losses leading to saturation of the detector univibrator system and consequently to minimum break at the interface. Conversely, if the pulse length is too short, sufficient voltage will not be generated to drive the recording potentiometer. The suppression value given on the figures indicates the number of inches that the zero voltage is displaced below the edge of the graph by application of bucking voltage. Suppression of this type yields a greater apparent break between oil and water. Since statistical uncertainty is increased in the same proportion, however, nothing is gained by excessive suppression.

Field Results

In a field test of the tool, three logs were run in underground storage wells at Hull, Texas. All three logs were entirely successful. Fig. 5 shows the log obtained in Magnolia's LPG Storage Well No. 2. It may be seen from the log that considerable information in addition to the interface location has been obtained. The sharp break at 1100 ft marks the position of the casing shoe. The large increase in counting rate at 1200 ft marks the top of the main cavern. Below this at 1242 ft, 1272 ft and subsequently at approximately 30-ft intervals, the pips indicate the positions of the tubing collars. The large break at approximately 1592 ft marks the LPG-brine interface.

In this particular well propane is in storage; brine is in the tubing and, of course, below the LPG in the cavern. The decrease in counting rate in going from LPG to brine is caused by increased gamma-ray scattering and absorption in the dense brine material.

Another interesting feature of the log is in the region between 1100 and 1200 ft. The log obtained in this region indicates a greater average density than the main part of the cavern and has been interpreted as a narrow neck at the top of the cavern, probably formed during the drilling operation and subsequently filled with diesel oil to protect the casing shoe during the leaching operation. The gamma-ray tool can, in general, indicate narrow regions in the cavern providing the average diameter is considerably less than the range of cobalt gamma-rays in LPG. When the cavern diameter increases above approximately three feet, one can no longer expect to obtain information about the diameter of the well directly from the scattered gamma-ray logs. However, the use of scattered gamma-ray logging in conjunction with material balance calculations can yield an areal profile for the entire well.

Summary

Experience obtained with this gamma-ray logging unit indicates that LPG-brine interfaces in underground storage wells can be clearly delineated by a simple type of scattered gamma-ray log. Counting rate changes obtained at interfaces are clear-cut. Sufficient break is obtained so that ambiguity in interpretation is virtually impossible.

In addition, the gamma-ray tool indicates the position of the casing shoe, the location and extent of narrow necks in the underground cavern and the position of the tubing collars. The position of all these features in the well may be determined to the same accuracy that one can determine the length of the logging cable. We have found in practice that interfaces may be located within one or two feet.

In addition, by metering the fluid input and at the same time locating the interface with the gamma-ray tool, one may obtain the cross-sectional area of an underground storage cavern as a function of depth.

A very attractive feature of the gamma-ray tool is that it is a portable and relatively cheap unit which may be used routinely at the storage site.

Acknowledgment

The authors wish to acknowledge their indebtedness to Well Reconnaissance Company, Inc., Dallas, Texas, for their cooperation in designing and manufacturing a downhole probe to our specifications and to the Natural Gas Department, Magnolia Petroleum Company, for their cooperation in arranging the field tests; to Dr. R. L. Caldwell for helpful discussions on the problem; to J. C. Petree for assisting in the data taking, and to the management of Magnolia Petroleum Company for permission to publish these results.

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2. Caldwell, R. L., and Sippel, R. F., Symposium on Nuclear Technology, American Chemical Society, Miami Meeting, April 1957.
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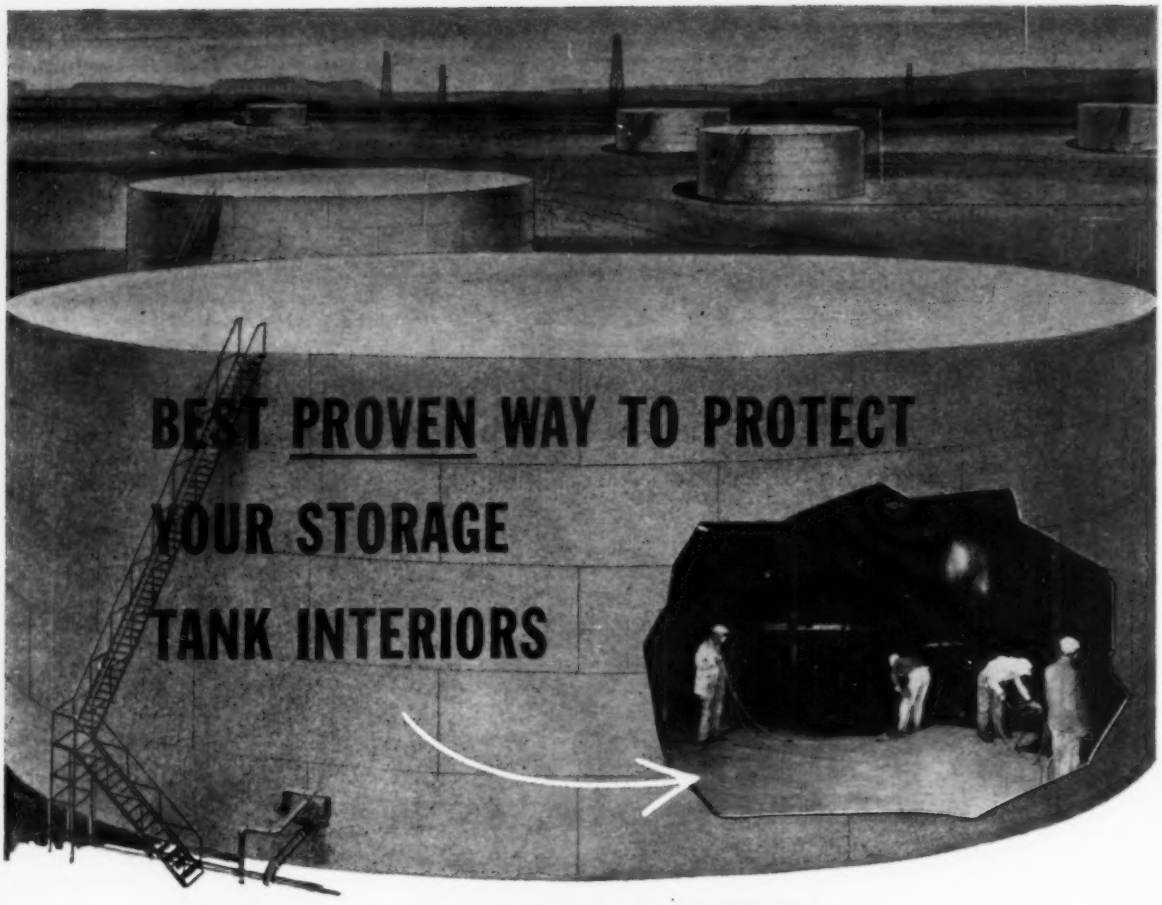

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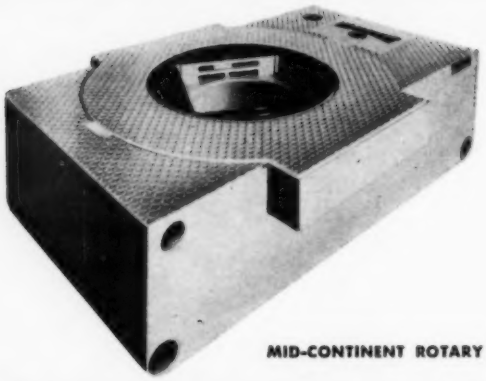

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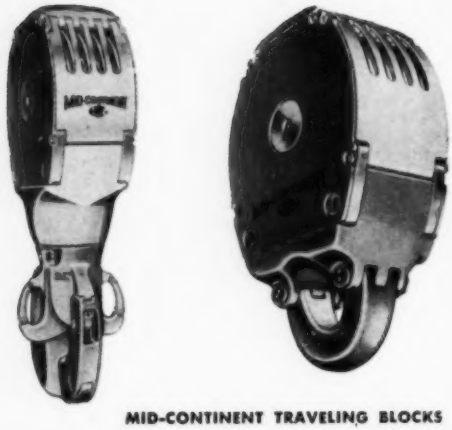

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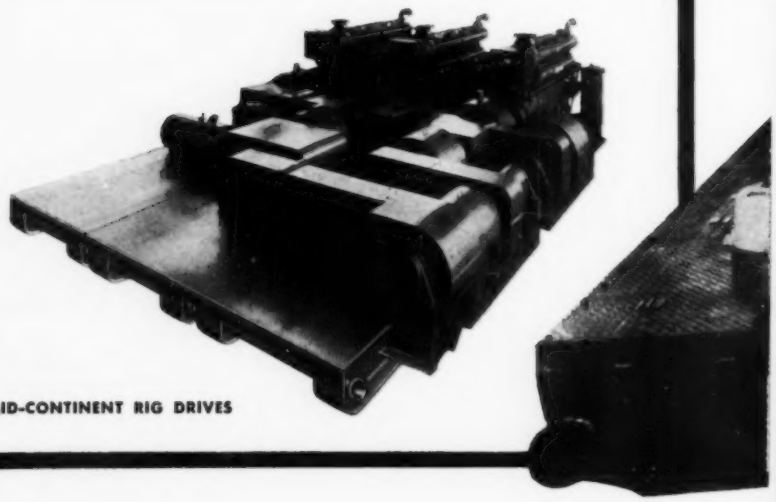

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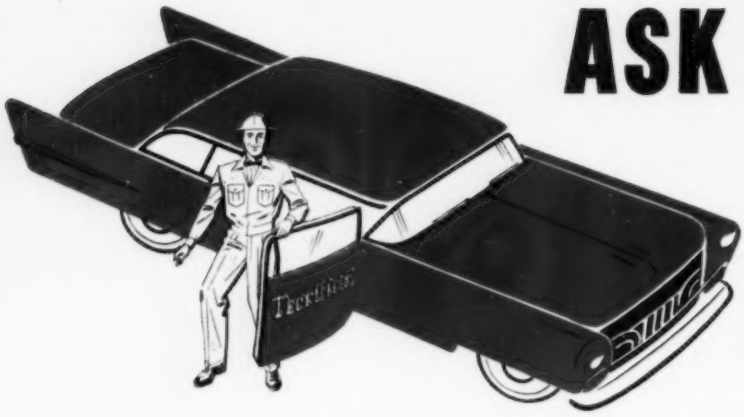

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PARIS BASIN

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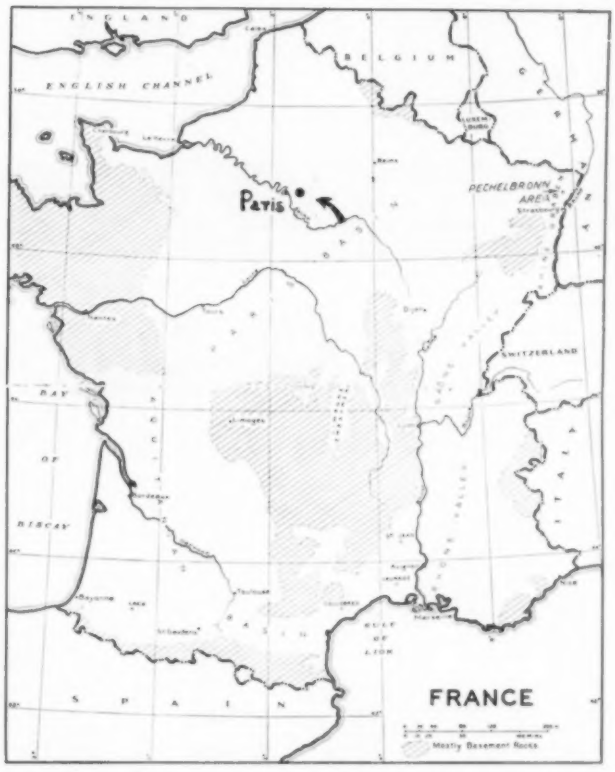

Discovery well of the Paris Basin is indicated by the arrow in this geographic map of France. (Courtesy AAPG).

Joseph A. Kornfeld
Consulting Geologist-Engineer
Tulsa, Oklahoma

METROPOLITAN FRANCE received a major impetus in its drive for oil self-sufficiency with the discovery of commercial oil late in February at a rank wildcat test on the Meaux anticline 27 miles east of Paris.

Situated in the heart of the Paris Basin, the Meaux anticline discovery opens the largest sedimentary basin in Metropolitan France. The Paris Basin is bounded on the west by Cherbourg and Tours, on the south by basement rocks near Limoges on the southeast by Dijon, on the east by the Rhine graben and on the northeast by basement rocks near Mezieres.

The potential discovery was made by Sainte de Recherches Petrolieres dans la region Parisienne (PETROREP) which holds a 1588-sq mile concession in the Paris Basin.

A drillstem test conducted at a depth of 6126 ft, with packer set at 6060 ft, recovered 52 bbl of oil during a 75-minute test. The crude tested 44.5 deg API, is sweet and contains very little sulfur.

More than 70 ft of oolitic, saturated limestone was encountered in the zone in which the drillstem test was run.

Producing horizon. The discovery horizon is correlated as the Bathonian stage of the Dogger group of Upper Jurassic age. The Bathonian produces light crude oil in the Northwest Germany salt basin including Fuhreberg, Hamburhen, Nienhagen, Steimbke, Thoren, Weitze, Suderbruch, and Hohenhorn.

Deeper possibilities are believed to exist in the Bajocian or the lower part of the Middle Dogger. The Aalenian formation of lowermost Dogger and Upper Liassic age produces in the Wesendorf, Oberg, Ehra, Calberiah fields of Northwest Germany.

Importance is attached to the potentialities which may exist below in the Keuper formation of the Triassic system. The Keuper is productive in the Nienhagen, Wietze, Molme, Berkopen-Olheim, and Eddesse fields of Germany.

Major structure. The Meaux anticline, on which the discovery well is situated, exhibits a major axis which trends for a distance of 12 miles along a northwest-southeast direction. The minor axis attains a maximum width of 6 miles. More than 300 ft of structural closure on top of the Dogger formation has been indicated from geophysical surveys. The existence of major faults on the Meaux anticline is not known from either surface mapping or geophysical work.

Exploration background. The discovery well was located on an anomaly made known by a reflection seismograph survey conducted for PETROREP by Compagnie Francaise de Prospecion Seismique (CFPS) and confirmed by shallow core drilling.

PETROREP obtained the concession from the French government during 1956. After a period of 15 months of preliminary work, largely under the direction of C. G. Carlson, Tulsa consulting geologist and adviser for PETROREP, drilling was commenced in October 1956. The well was spudded in Tertiary rocks.

Nearest structural control lies 27 miles to the southeast on the Courguoux prospect where another firm encountered showings of light oil in the Dogger formation in drilling to a depth of about 10,100 ft.

Distant from production. The nearest producing oil field in France lies 228 miles due east of the discovery in the Rhine graben north of Strasbourg

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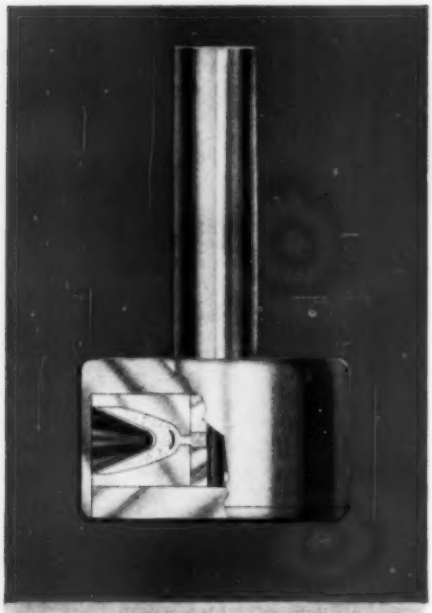

Any lumberman will tell you that the way the wedge is placed determines the way a log is split along the grain of the wood—faulty placement and what should have been top-grade lumber turns out to be fire wood.

Any oilman will concur that for a successful fracture job, the placement of the fracture determines the end result after the well is treated.

Welex 8-Way Frac-Jet gives you just the start you need to control fracturing along the bedding plane of the rock. Actual tests by a major oil company proved this when horizontal fracturing was obtained in two separate zones in four wells 50 feet apart, each equidistance from an injection well in the center. Two shots with the Welex Frac-Jet and subsequent fracture treatment provided fractures from the center well to all four test wells—50 feet apart—with less than 2 feet variance in either plane *completely around* the injection well.

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where the old Pechelbronn area is nearing exhaustion after more than 40 years of oil production.

The principal oil-producing area of Metropolitan France is the Parentis oil field situated 338 miles southwest of the Meaux anticline well but in the Aquitanian Basin north of the Spanish Pyrenees Mountains. Parentis, Europe's largest oil field, is in the heart of the Aquitanian Basin southwest of Bordeaux. It produces 26,834 bbl of oil per day from 23 producing oil wells. Parentis produces from an oil column of more than 1200 ft from a carbonate sequence in the Lower Cretaceous system on a highly faulted anticline. Also in the Aquitanian Basin are the Lacq oil and gas fields, situated 400 miles southwest of Paris.

French contractor. The Meaux anticline well is being drilled with rotary tools and is now below 6140 ft on a 10,000-ft contract with Compagnie Forage Petrolier (FORENCO) which operates a dozen rotary rigs throughout Metropolitan France.

Major ownership in PETROREP is held by Petrofrance which has a 51 percent interest. The remainder is held by the Rothschilds and other French investment groups. ★ ★ ★

Stancal, Gulf Drill Deep Offshore Bahamas Test

Bahama California Oil Company and Bahamas Gulf Oil Company, are drilling an exploratory test well on Cay Sal Bank, approximately 180 miles southwest of Nassau. Initial work at the site began in early February with actual drilling operations starting March 22.

The well is being drilled under oil prospecting licenses held by the two firms, wholly-owned subsidiaries of Standard Oil Company of California and Gulf Oil Corporation, respectively. The site was selected after two years of extensive seismic work over Cay Sal Bank at a cost of over $400,000.

A spokesman for the Petroleum Board of the Bahamas government estimated that the well will cost nearly $3,000,000 and will be one of the most expensive ever budgeted. It will be drilled to a maximum depth of 15,000 ft from a self-contained platform located in 30 ft of water.

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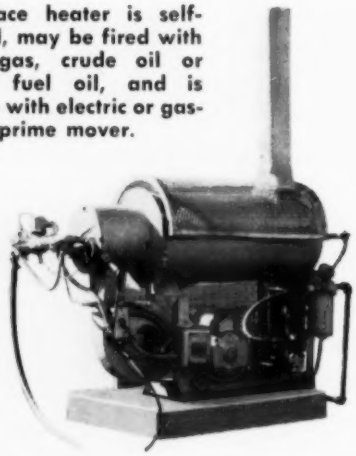

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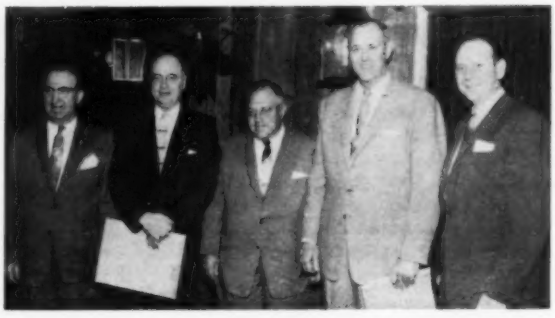
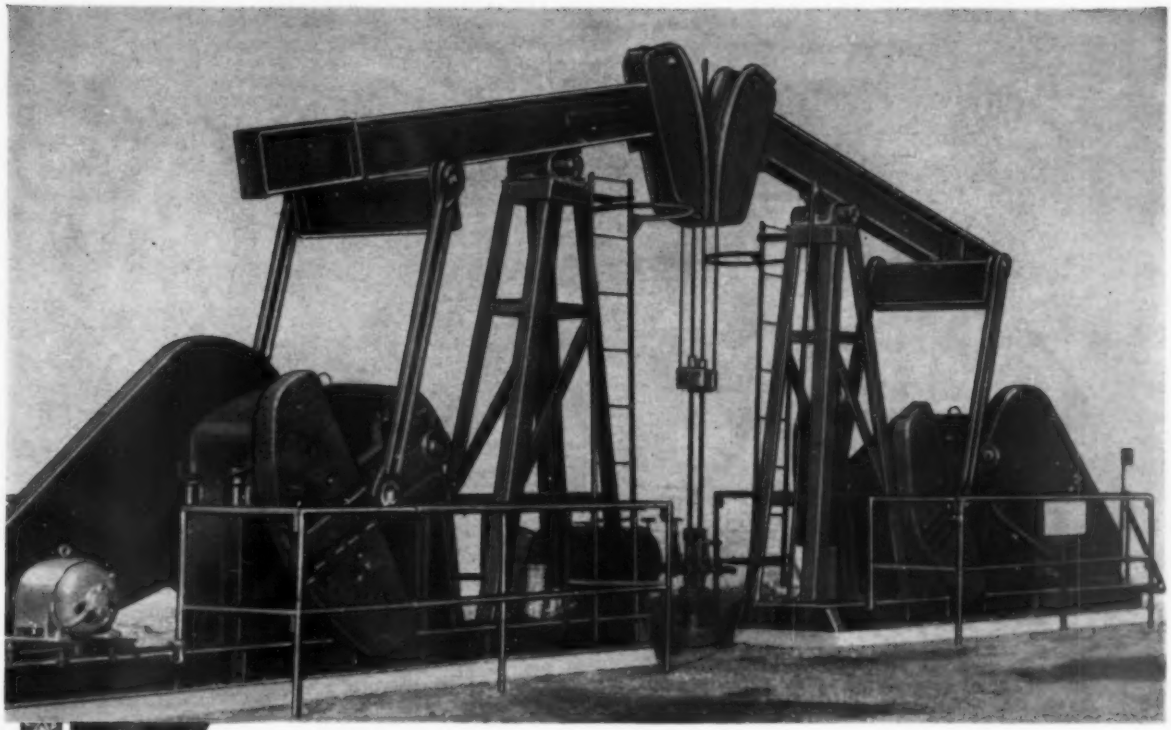
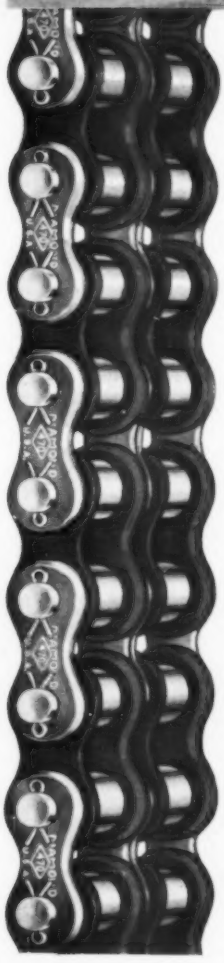


Three new members of the Los Angeles Chapter of Nomads recently inducted are shown standing between Earl Daniels of Hydril Company (left) and Art Marshall of H. C. Smith Oil Tool Co., ritual master. Left to right, Harry G. Smith of A. O. Smith, regular member; Lee M. Boortz of Halliburton, associate member; Thornley (Tiny) Roe of Halliburton, associate member.

Houston Nomads added six new members to its rolls recently. They are: B. J. Gross, WKM; K. P. Morris, Lee Construction; A. D. Lee, Lee Construction; E. F. Hannon Jr., Baker; Don Hanson, Petroleum Week, and J. E. Woods, National Supply.





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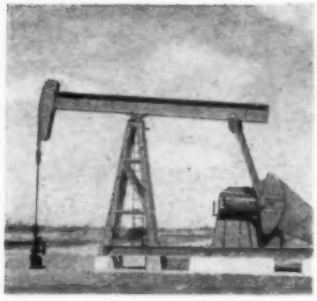

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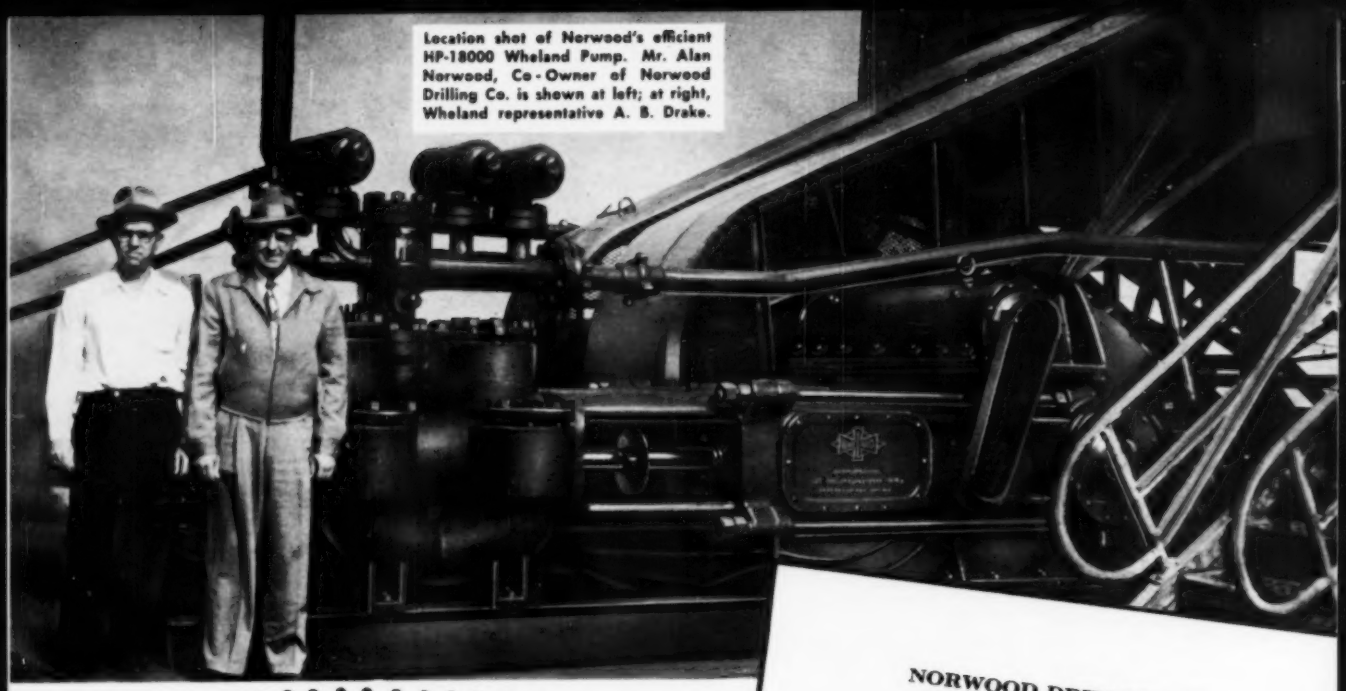

Location shot of Norwood's efficient HP-18000 Wheland Pump. Mr. Alan Norwood, Co-Owner of Norwood Drilling Co. is shown at left; at right, Wheland representative A. B. Drake.

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NORWOOD DRILLING COMPANY

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EXPLORATION ACTIVITIES

FLORIDA

Deep Swampland Wildcat Gets Dead Oil, Water

Florida's deep wildcat is still making hole after finding heavy oil in a net 86 ft of dolomite and limestone at 9680-792 ft. Humble Oil & Refining's No. 11 State-1004, in the Everglade Swamps of Palm Beach County, tested a zone that yielded 4641 ft of oil-cut salt water and 25 ft of oil-cut mud on a 240 minute test. The oil had a hydrogen sulfide odor and salty taste, operators say. The contractor, Dorris Ballew, is drilling below 12,000 ft on a 15,000 ft contract.

Humble's well is located one-half mile southwest of the Miami canal and 20 miles from the settlement of Okeelanta.

BRAZIL

Petrobras to Try Luck in 13

The government-owned Brazilian Petrobras has planned 13 wildcats during the first half of the year. The tests will be drilled in the Upper and Middle Amazon Basin, where geologists have recently conducted extensive surveys. All present production comes from the state of Bahia, and totals less than 1500 bbl per day. Some oil has been found in tests in Alagoas, in northeastern Brazil.

PENNSYLVANIA

New Johnstown Dome Gas Pool

Fracturing the significant Williams discovery well in Somerset County by The Peoples Natural Gas Company increased the open flow of gas for a 24-hr period from the original 900,000 cu ft to 10,285,000 cu ft. The well, drilled on the C. E. Williams farm, opened a new gas pool on the Johnstown dome of the Laurel Ridge anticline. Snee and Eberly, independent oil and gas operators, were partners in the wildcat venture.

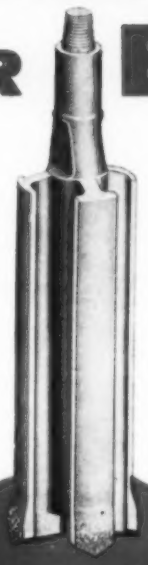
Farm owner Williams and the Robert E. Perry Boy Scout Council will share royalty proceeds from the well, since it was drilled on the Boy Scout Roaring Run Reservation segment of the Williams farm.

LOUISIANA

Ark-La Gas Discovery Makes 21,000,000 Cu Ft

Arkansas Louisiana Gas Company has completed a Cotton Valley "D" sand discovery well in the Calhoun field of Ouachita Parish, about 15 miles west of Monroe. The company filed an open potential report of 21,000,000 cu ft of gas per day with 4 bbl of condensate per 1,000,000 cu ft of gas for the Fuller No. 1, from perforations in the upper 20 ft of 26½ net ft of pay between 9234 ft and 9257 ft. The Fuller well is a mile east of Arkansas Louisiana's No. 1 Pipes Estate, which was completed as a gas and condensate discovery in the Cadeville sand without penetrating the Cotton Valley "D." Both the Fuller and the Pipes tested three commercially productive gas and distillate sands in the Travis Peak between 6851 and 8746 ft. A third test in the Calhoun field, the Ervin McDaniel No. 1, location one mile southwest of the Fuller No. 1, is drilling below 7000 ft.

FABRICATED STAR BITS



The Fabricated Star Bit shown here has been designed especially for big hole drilling in hard formations. Far more efficient than the old style spudding bit and the big hole paddle-type bit, these Star Bits are custom-engineered to suit the particular hole size and the capacity of the drilling machine used.

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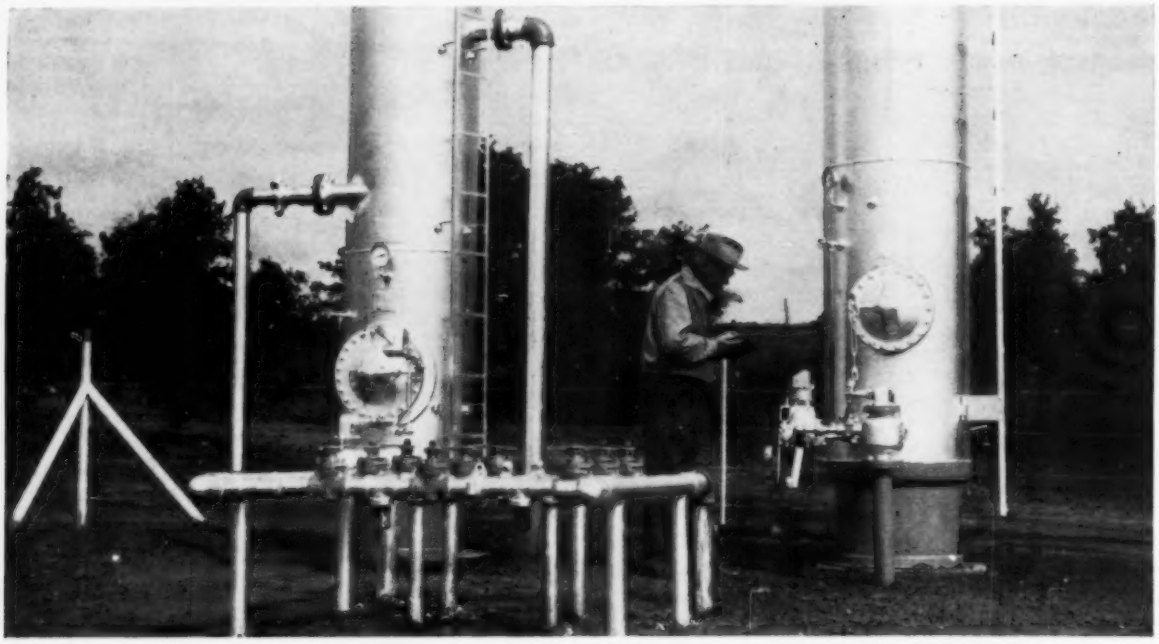

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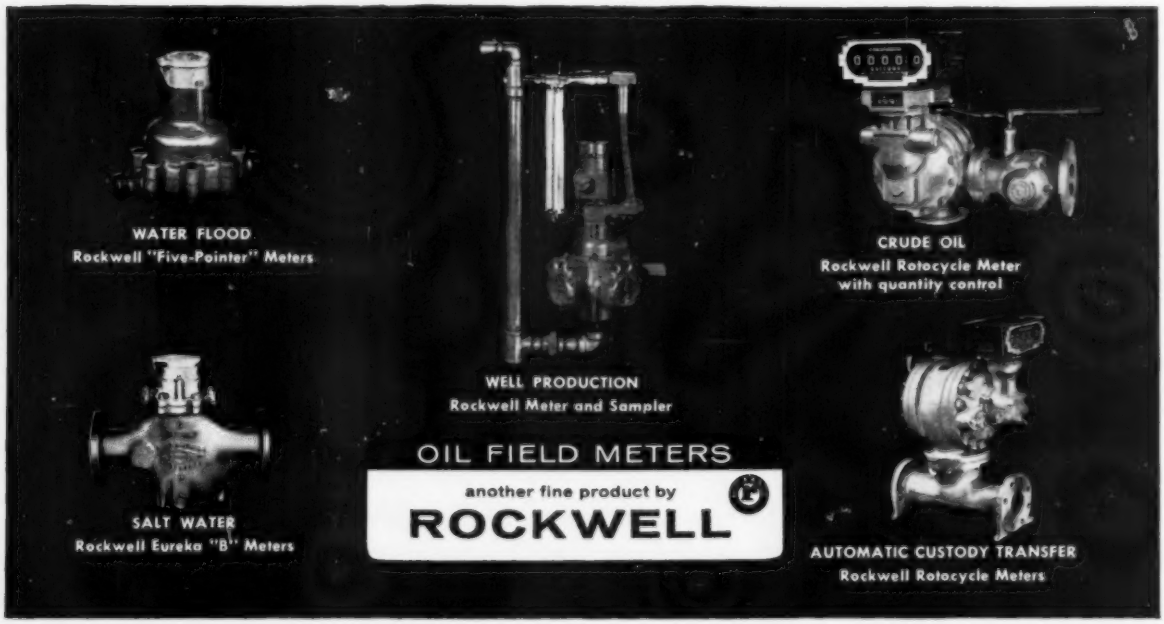

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SAHARA

Phillips Shares Exploration Permit with French

Phillips Petroleum Company has been awarded exploration permits on a concession in the Sahara Desert of Algeria. Consisting of 815,430 acres in the vicinity of the prolific Hassi Messaoud oil field, the concession has been granted to a group consisting of Phillips and two French companies. Phillips will have 25 percent interest in the venture which marks the company's first entry into North Africa.

The other companies are COPEFA (Compagnie Francaise des Petroles France-Afrique), which is the operator, and OMNIREX (Omnium des Recherches et Exploitations Petrolieres). Geophysical exploration has begun.

VENEZUELA

Pure, et al, Find New Oil In Eocene C-2 Sand

A group composed of Pure Oil Company, Signal Oil & Gas, Standard of Ohio and Hancock Oil Company have discovered their second important oil producing formation in Lake Maracaibo.

The new reservoir is the Eocene C-2 sand. On tests of the formation from 10,044 to 10,200 ft, the Centro Lago 4-X well flowed at the rate of 5136 bbl a day through a ¾-in. choke. The oil tested at 27.5 deg specific gravity.

The well is the fourth drilled and by far the best producer brought in by Pure and its associates in their 28,000-acre Lake Maracaibo concession.

SAUDI ARABIA

Aramco Tells Results of Manifa, Khurais Tests

The Arabian American Oil Company has announced completion results of two wildcat wells in which oil was discovered last fall. One of the wells, known as Manifa No. 1, was drilled in the Persian Gulf eight miles off the shore of Saudi Arabia. The other well, known as Khurais No. 1, was drilled on land 90 miles northeast of Riyadh, the capital of Saudi Arabia.

Manifa No. 1 has been completed through perforations from 7715 ft to 7800 ft and from 7810 to 7865 ft in the Yamama formation, which has been identified as Lower Cretaceous. The well was drilled to a total depth of 9637 ft and plugged back to 7892 ft. This is the first well to have discovered oil production in Aramco's Concession area from the Yamama formation, which lies above the Arab Zone, the principal producing zone in Aramco's onshore fields. The crude oil from the producing interval at Manifa No. 1 is sour and has an API gravity of approximately 26 deg. Initial tests have indicated the Yamama formation to be highly prolific in this well.

Khurais No. 1 has been completed for production from the Arab-D member and from the upper part of the Jabaila formation, both of which are of Upper Jurassic age. It was plugged back to 4975 ft after reaching a total depth of 10,621 ft. The crude oil from Khurais No. 1 is sour and has an API gravity of approximately 33 deg. Initial tests have indicated flowing rates of approximately 3000 to 4000 bbl per day.

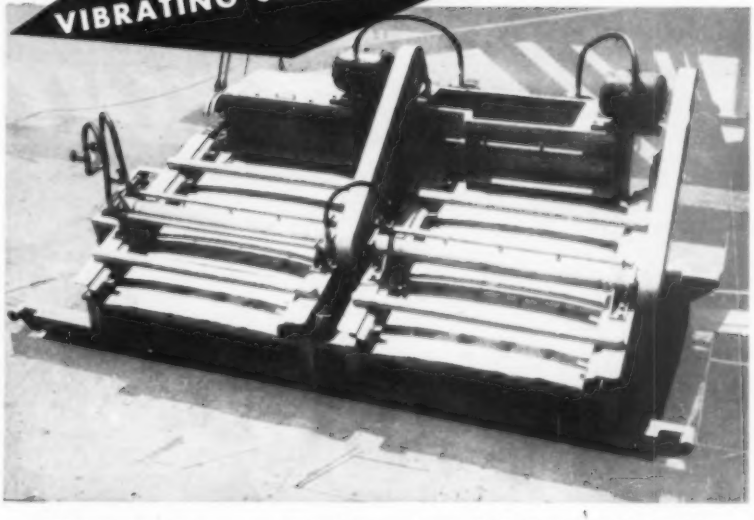
KENTUCKY

130,000 Acre Deal Closed In Stearns, Border Area

Barnwell Production Company has purchased oil and gas leases on 130,000 acres straddling the Kentucky-Tennessee state line from Stearns Coal & Lumber Company. The spread lies west and southwest of Stearns. No drilling in recent years has been done on the property, although records show that a salt water well, drilled in 1918, found oil at a depth of about 200 ft. Area in which this well was drilled, in McCreary County, is included in Barnwell's lease.

For the "MR. CAP" They Chose a

Thompson VIBRATING SHALE SHAKER



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CALIFORNIA

Phillips to Explore Industrial Area

Union Oil Company of California has put a block of land together for exploratory drilling southeast of the town of Saugus, comprising approximately 500 acres of lands acquired from the Golden Triangle Industrial Park organization and the Bermite Powder Company. First well will be located in the NW ¼ of Section 25, T4N, R16W, SBBM, on the Bermite Powder Lands. If successful, follow-up drilling will be conducted on the Golden Triangle Industrial Park lands, which lands are presently being developed for large and small industries.

Bishop Makes Try for Vedder in Faulted Area

Bishop Oil Company has spudded Pongratz Well No. 5 on a 160-acre lease in Kern County, and is drilling ahead at 1100 ft. The company's objective in the heavily faulted area is the Vedder Sand from which Shell Oil Company recently brought in a 100-bbl per day producer about 500 ft to the south. Anticipated total depth is 1860 ft.

Bishop already has four wells on the lease producing oil from a higher formation.

The newly spudded well is located 160 ft north and 110 ft east of the southwest corner of Section 10, T27S, R28E, MDBM, in Kern County.

ALABAMA

Successful Stepout Perks Citronelle Interest

A one-mile southeasterly extension to the Citronelle field, Mobile County, has been completed by Petroleum Products Development Company. The well, the No. 1 James and Phillis Roberts Heirs, pumped 266 bbl of oil a day from Rodessa perforations at 10,994 to 11,010 ft. The extender was drilled to a total depth of 11,561 ft and cemented at 11,241 ft.

Other activity in the otherwise quiet Citronelle area includes three deep wildcats less than three miles from the field. Drilling the 11,000 to 12,650 ft tests are: Magnolia, to the southeast; Jett Drilling, west of Citronelle, and a Magnolia and Zack Brooks Drilling joint venture northwest of the field.

TEXAS

Stephens County Discovery Flows 600 Bbl Per Day

Ryan Consolidated Petroleum Corporation's No. 6A Mrs. Ollie Smith has been completed as an oil discovery in Stephens County.

Well flowed 120 bbl of 41 deg oil through a 10/64-in. choke on a four hour test from the Conglomerate through perforations at 3875-95 ft.

The company had previously completed a discovery well in another conglomerate zone, believed to be a separate pool. This well spots 1866 ft to the northeast of more recent discovery. Ryan holds 1200 acres in the block.

Rank Ellenburger Test Set for Waggoner Pasture

Cities Service Oil Company is drilling a rank Ellenburger test in North Central Texas. The Wilbarger County well is on the Waggoner ranch and will be drilled to the Ellenburger, expected at about 5800 ft. The test is Lawson-Waggoner Y No. 1, approximately 2400 ft from south line and 1850 ft from the east line of Section 2, Block 2, H&TC Survey. It is 15 miles south of Vernon and five miles southwest of nearest production in the Paradise Caddo field. Cities Service has half interest in the test with E. C. Lawson and will operate.

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HERCULES Duplex Polished Rod Stuffing Boxes are constructed from high grade malleable iron (55,000 PSI Tensile Strength) and are rated 3,000 pound test. Flexibility and the cone-shaped Packing Rings are the combination of factors which make the HERCULES Stuffing Box without equal for any pumping situation.

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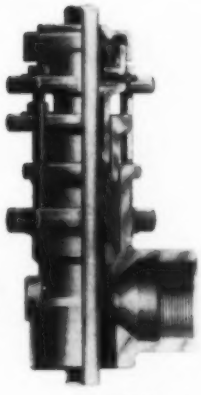

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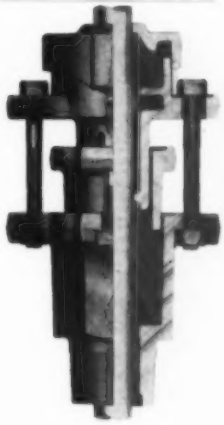

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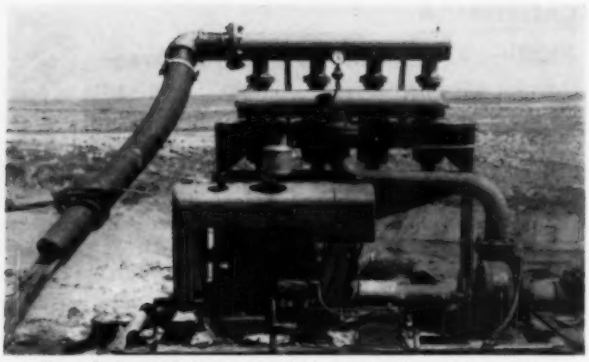
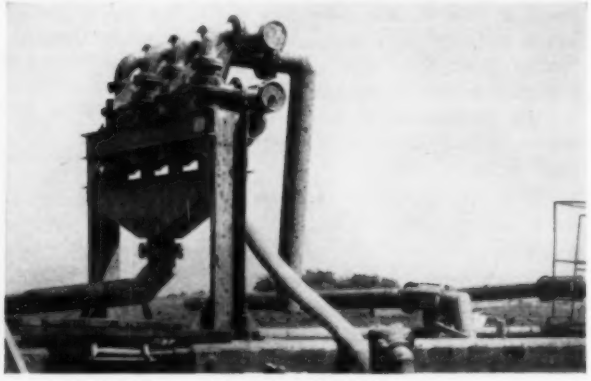


These #4 Dorrco D-Sanders installed above in San Juan Basin, New Mexico, and below in Cleveland County, Oklahoma, illustrate the versatility of the unit for either operation in conjunction with pit or detached and mounted above mud tank (this is a modified unit).



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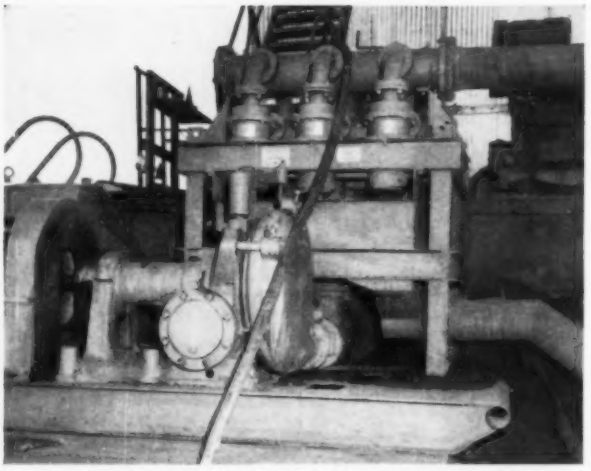

No. 6 Dorrco D-Sander installed on an Oklahoma rig drilling ahead to new record depths.

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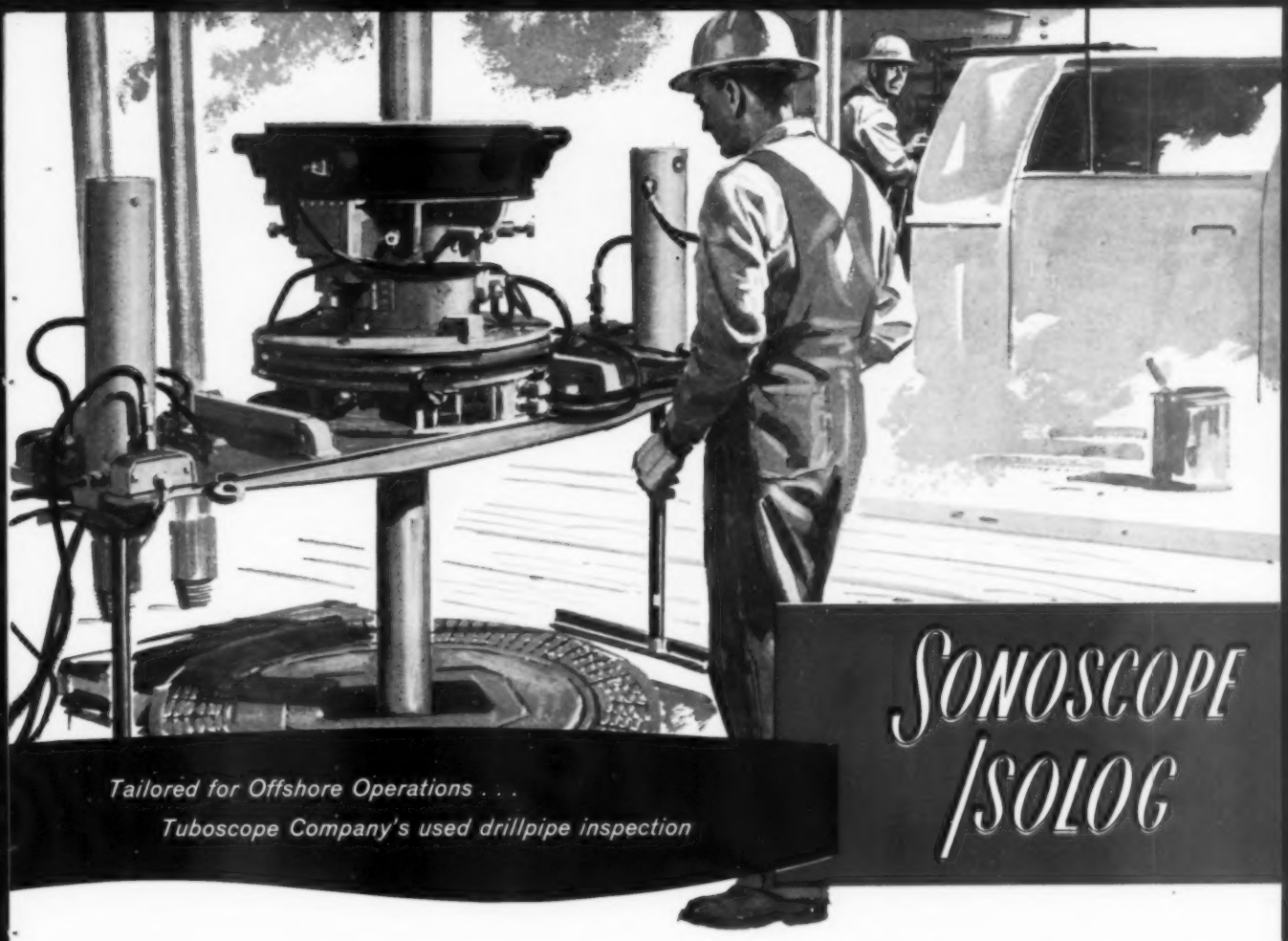

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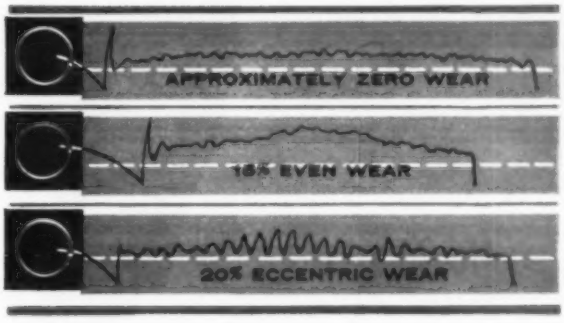

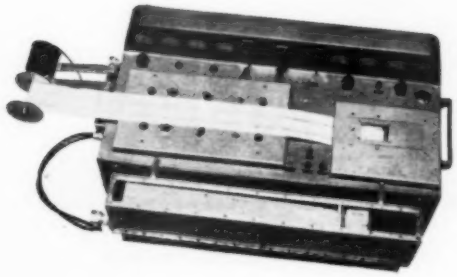

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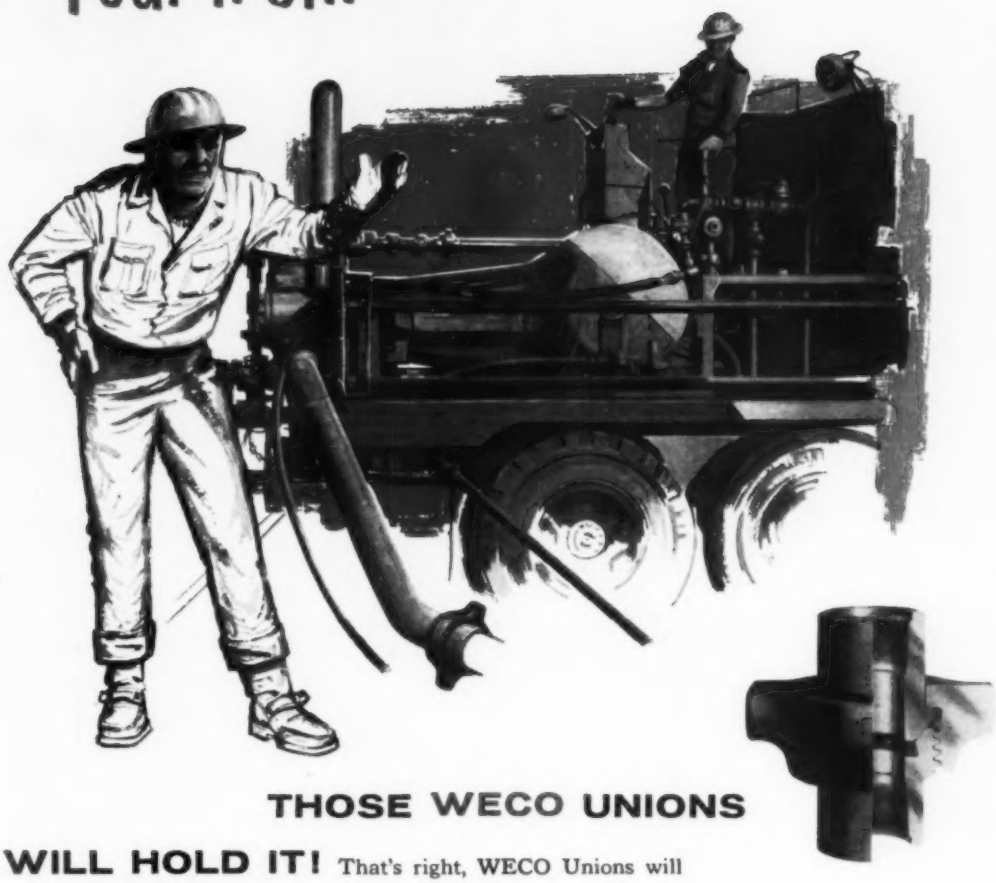

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New Southwestern Officers include: (seated) E. W. Showen, H. P. Logan, and (standing) John McNaughton, J. M. Garlick, W. R. Johnston, and Alan Antweil.

Southwestern District API Talks Air Power and Oil

Missiles, the Technical Air Command, and the general world military situation were "briefed" for New Mexico and Texas oil men attending the Southwestern District spring meeting of the API Division of Production in Fort Worth.

Linking U. S. air power and oil was General O. P. Weyland, USAF, one of three speakers at the only general session of the Fort Worth meeting March 12-14.

Other main speakers were Milton C. Lightner, president of the National Association of Manufacturers and chairman of the board of Singer Manufacturing Company, and D. L. Connelly, Warren Petroleum Company and API vice president for production.

Connelly addressed the group and presented the API "Citations for Service." Receiving the awards were A. E. Chester, Alden S. Donnelly, and J. H. Sullivan.

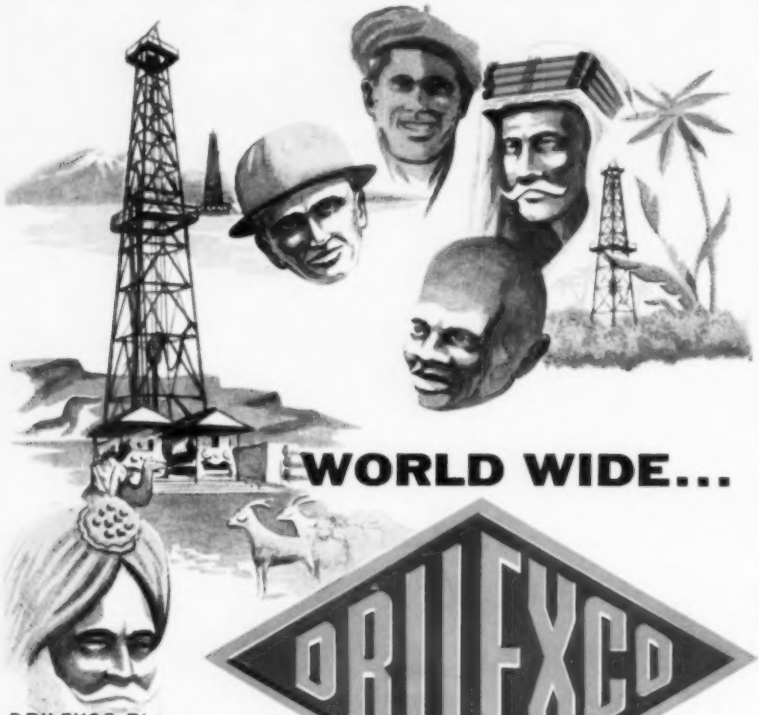
Other group sessions and study committee meetings dominated the three-day meeting. More than a dozen study committees discussed subjects ranging from drilling practices to supervisory development. Eleven technical papers were presented in the course of the conclave. Of more than casual note were several papers on various aspects of development and practices in the Four Corners area.

Naming of new officers for the Southwestern district highlighted the activities of the third day of the annual gathering.

E. W. Showen, Gulf Oil Corporation, Midland, was elected district chairman.

Regional vice chairmen appointed were Jerry Ormand, Ormand Drilling Company, Midland, chairman for West Texas; J. M. Garlick, Shell Oil Company, Wichita Falls, North Central Texas; Alan Antweil, Hobbs Pipe & Supply Company, Hobbs, vice chairman for Southeast New Mexico; H. P. Logan, El Paso Natural Gas Company, Farmington, Northwest New Mexico; L. L. Cox, Cities Service Oil Company, Levelland, South Plains; T. C. Aitken, Sun Oil Company, Gainesville, Northeast Texas vice chairman. John P. McNaughton, Neville Penrose, Inc., Fort Worth, was elected secretary-treasurer.

Retiring district chairman W. R. Johnston of Aspen Drilling Company, Albuquerque, becomes chairman of the district advisory committee.



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Since 1929 Drilexco rigs and crews have been bringing in producing wells throughout the world. This record of operation has been made possible because of using the best equipment available and a continuous advancement in drilling techniques.

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ENCLOSED FIND:

19 years of engineering

Well service engineering has been the basic function of The Western Company since its beginning in 1939. This concept of research and field engineering in completion and remedial work has led to the creation of many new services and products for greater effectiveness in well servicing.

Western's Fracture Initiation Process* represents one of the more recent advances, and is in wide use throughout the Western area because of its unprecedented performance in initiating fractures and controlling the fracturing process.

F.I. was conceived and developed by research and field engineers to gain greater control in fracturing. Its ability to create and extend horizontal fractures has made it the most effective completion method available.

Fracture Initiation process is only one of many examples of Western engineering that provides more effective recovery methods. You will find the same engineering advantages in all Western products and services.

Western Engineering Makes the Difference!

*Exclusive with Western. Details on request.

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What's doing in DRILLING

Floating Drilling Barge Pleases Owners

Delegates to a recent southern district meeting of the American Petroleum Institute heard a report on "CUSS I", the floating drilling barge developed by Continental Oil Company, Union Oil Company of California, Shell Oil Company, and Superior Oil Company. Company spokesmen stated that the barge can work in deep water at costs comparable to those onshore.

Most recent venture for the barge was on two exploratory programs. In the first, it took an average of 12.8 days to drill each of eight core holes to an average depth of 5000 ft. In the second, it completed six 3530-ft core holes in 6.6 days each.

Principal advantages of the floating drilling method, said the operators, are:

1. Its adaptability to water of almost any depth, work having been done in depths up to 400 ft,
2. Portability of the floating barge, and
3. Its submerged wellhead equipment, enlarged mud storage capacity, and added room for blowout preventers.

Nigeria Drilling Steps Up

Drilling activity in the small African republic of Nigeria is steadily climbing. Shell and British Petroleum now operate three rigs and are currently mounting a fourth on a barge for inland marsh drilling. Drilvo, a Dutch affiliate of Drilling and Exploration is currently running three rigs. Monty Garrison, former manager for Drilvo, has set up the International Drilling Company and is planning to bring in two 10,000-ft rigs.

Gulf Oil Salvages Drilling Mud

A liquid mud reclamation system inaugurated by Gulf Oil Corporation in the Timbalier Bay field of Louisiana has resulted in a savings of almost a million dollars for the company in little over a year.

The reclamation system consists of two storage barges, two decanting-type centrifuges and a disposal pit and was designed to recover muds from wells for reuse in other drilling and workover operations. Company representatives have said that three prerequisites for economical operation of the system are a shallow-water field in which a concentration of drilling and workover operations are underway, use of only a single type mud to hold equipment needs to a minimum, and availability of equipment to centrifuge and store the volumes of surplus mud built up in normal drilling operations.

Drillers to Welcome Bridge in Four Corners

A definite boost to development of the southeastern Utah portion of the Paradox Basin is planned in the form of a bridge across the San Juan River south of Aneth field. Utah plans construction of a surfaced road joining the Blanding-Bluff highway and offering service to the oil fields along the San Juan River. The project will cost about $550,000. The Navajo tribe has contributed $200,000 to the project and offers of money and assistance from oil companies have brought the total available for the project to around $400,000.

There is at present only footbridge communication across the river. To get from a location on one side of the river to one on the opposite side often requires a drive of 200 miles or more.

AAODC To Sponsor Drilling Mud School

The "Principles of Drilling Fluid Control" training program will again be available to drilling field personnel throughout the country, in a new series of courses scheduled to begin early this spring. Sponsored by the American Association of Oilwell Drilling Contractors, the courses are conducted by the Petroleum Extension Service of the University of Texas.

An instructor travels to field locations to present the 30-hour program, given in 10 three-hour periods. Morning and evening classes are arranged to enable men working all three tours to attend.

The AAODC has taken the first step in scheduling the new series by polling members of the organization on location preferences and approximate attendance. Contractors who wish to provide the training for their own employees may make arrangements with AAODC headquarters, Dallas, Texas.

Soviets Claim World Drilling Record

Russia claims that a Soviet drilling crew set a world record by making 128,572 ft of hole in one year with a single rig, "exceeding an American mark of 125,465 ft established in 1956."

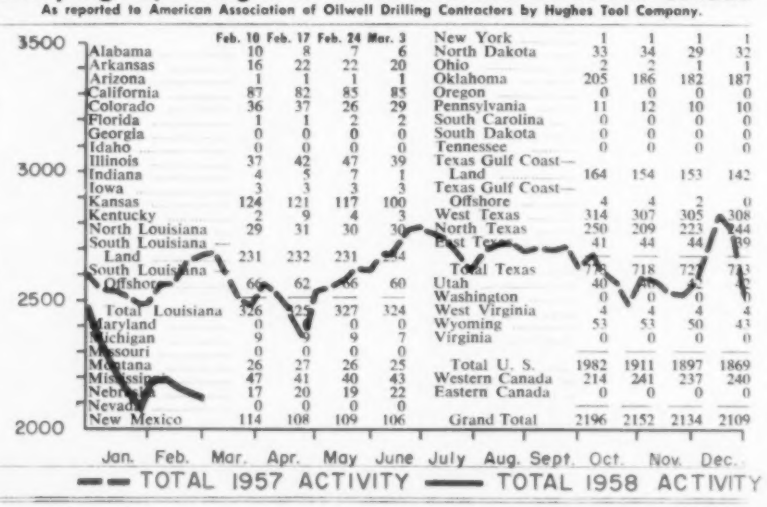
The new record, reported in *Pravda*, is credited to a drilling crew in the Pre-Azov Oil Trust while working on the Kuban Steppe near Krasnodar. The crew reportedly completed 21 wells in the 12-month period.

Another crew in the same area is also said to have broken the American record. It completed 22 wells and made 128,493 ft of hole with a single rig during 1957.

Rotary Rigs Operating in Oil Fields of United States and Canada

As reported to American Association of Oilwell Drilling Contractors by Hughes Tool Company.

	Feb. 10	Feb. 17	Feb. 24	Mar. 3
Alabama	10	8	7	6
Arkansas	16	22	22	20
Arizona	1	1	1	1
California	87	82	85	85
Colorado	36	37	26	29
Florida	1	1	2	2
Georgia	0	0	0	0
Idaho	0	0	0	0
Illinois	37	42	47	39
Indiana	4	5	7	1
Iowa	3	3	3	3
Kansas	124	121	117	100
Kentucky	2	9	4	3
North Louisiana	29	31	30	30
South Louisiana — Land	231	232	231	234
South Louisiana — Offshore	66	62	66	60
Total Louisiana	326	325	327	324
Maryland	0	0	0	0
Michigan	9	9	9	7
Missouri	0	0	0	0
Montana	26	27	26	25
Mississippi	47	41	40	43
Nebraska	17	20	19	22
Nevada	0	0	0	0
New Mexico	114	108	109	106
New York	1	1	1	1
North Dakota	33	34	29	32
Ohio	2	2	1	1
Oklahoma	205	186	182	187
Oregon	0	0	0	0
Pennsylvania	11	12	10	10
South Carolina	0	0	0	0
South Dakota	0	0	0	0
Tennessee	0	0	0	0
Texas Gulf Coast — Land	164	154	153	142
Texas Gulf Coast — Offshore	4	4	2	0
West Texas	314	307	305	308
North Texas	250	209	223	244
East Texas	41	44	44	39
Total Texas	773	718	727	733
Utah	40	43	42	42
Washington	0	0	0	0
West Virginia	4	4	4	4
Wyoming	53	53	50	43
Virginia	0	0	0	0
Total U. S.	1982	1911	1897	1869
Western Canada	214	241	237	240
Eastern Canada	0	0	0	0
Grand Total	2196	2152	2134	2109



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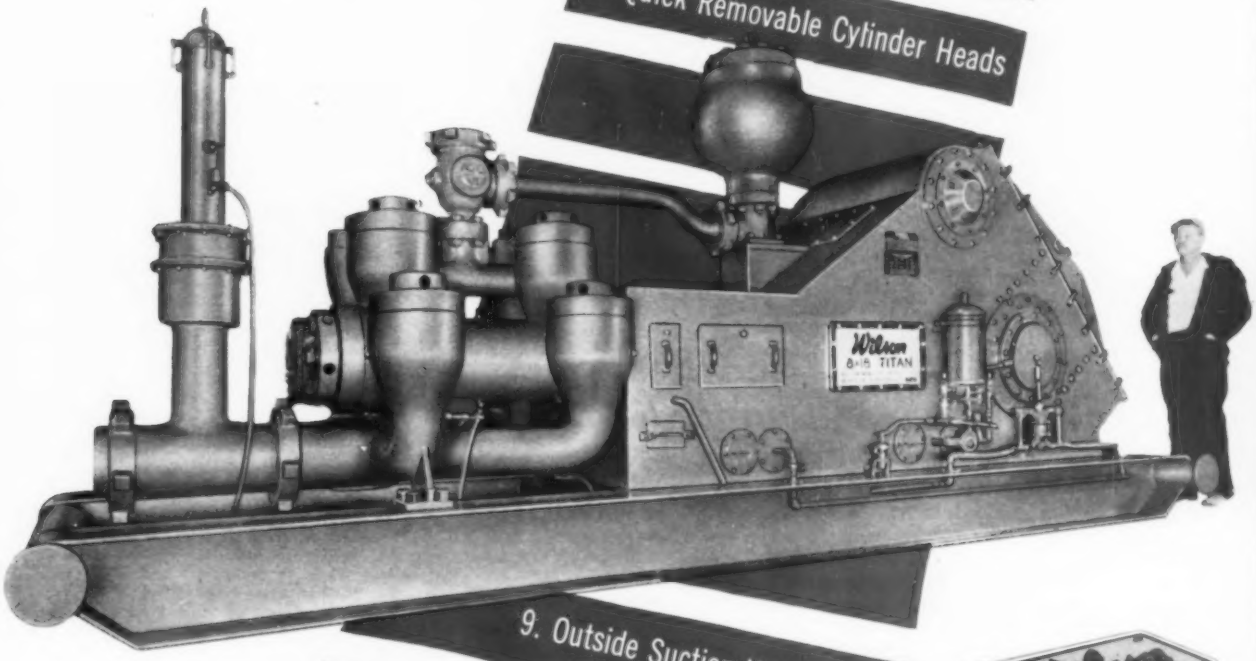
1. All-Steel Frame
2. Chain Drive - No Gears
3. Alloy Steel Fluid End
4. Suction Flow Equalizer
5. Low Cost Per Horsepower
6. Low Weight Per Horsepower
7. Quick Removable Valve Covers
8. Quick Removable Cylinder Heads

WILSON PUMPS HAVE THESE FEATURES AND MANY MORE

WILSON HAS A PUMP TO FIT ANY NEED

BETWEEN 300 AND 1050 HORSEPOWER

It's sensational! A 1050 H.P. pump that weighs ONLY 35,300 pounds complete with pistons, rods, liners, valves, skids, and Suction Flow Equalizer.



9. Outside Suction Valve Pots
10. Tapered Threads on Rods and Pony Rods
11. Full Pressure Lubrication with Warning Alarm
12. Self-aligning Roller Bearings on all Full Rotating Shafts

ONLY WILSON PUMPS HAVE ALL THESE FEATURES

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MANUFACTURING CO., INC.
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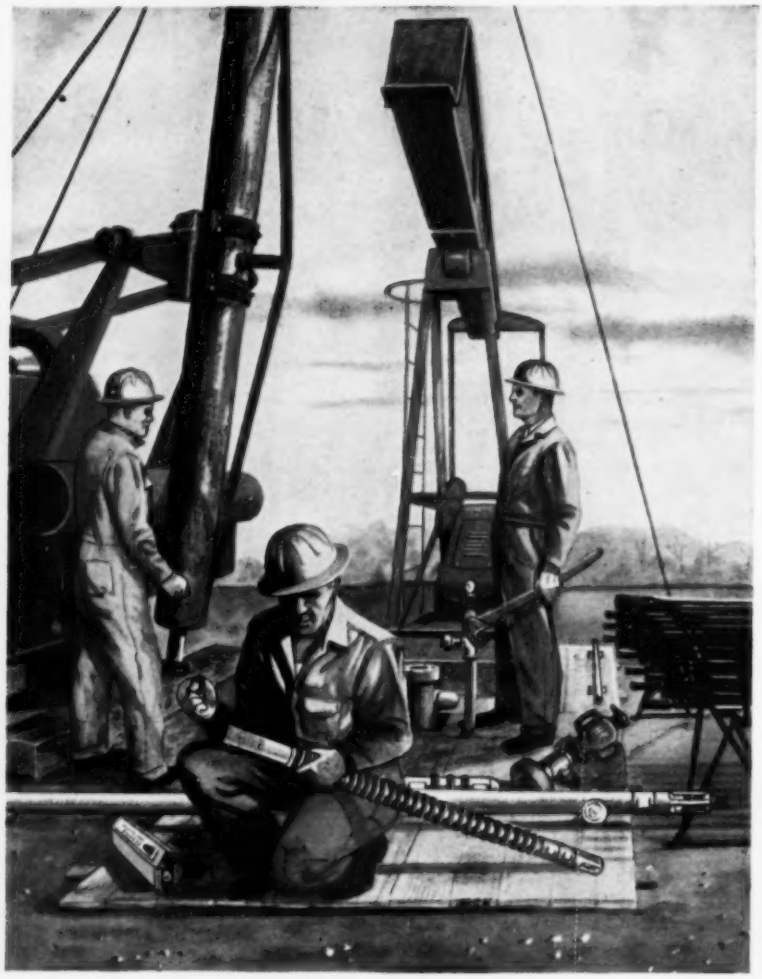

"FLEXITE"® Rod Pumps
are easy to make up in the field

The reason you will get such long and efficient service from a Flexite pump is because of five exceptional features. Any single one of them would be desirable: all five make the Flexite the best all-around pump in the oil patch. The unusual success of the pump is due to the Flexite Ring Plunger.

Easy to Make Up — *Flexite Ring Plungers are easy to make up in the field. No special tools, fixtures, nor instructions are necessary.*

Perfect-Sealing, Free-Falling — *The step-cut design allows Flexite Rings to expand to a positive seal on the upstroke, but fall freely on the downstroke.*

Non-Swelling—*Flexite Rings are precision ground for an exact fit in the barrel tube. No swelling nor soaking to size before running in.*

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Wide-Design Rings — *For deep-well pumping, wide rings afford a greater sealing area. Wide rings will fit standard A.P.I. pumps.*

Check with your store, or another operator. They'll recommend Flexite also.

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"Best Pumps in the Oil Patch"

B-150

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Drilling

Floating Drilling Platforms Under Study

Drilling through a floating doughnut may be the economic key in the search for offshore oil reserves where the depth of water is too great for fixed or mobile pile-type drilling platforms. The ability of this operation has been demonstrated on the Pacific Coast and in the Gulf of Mexico.

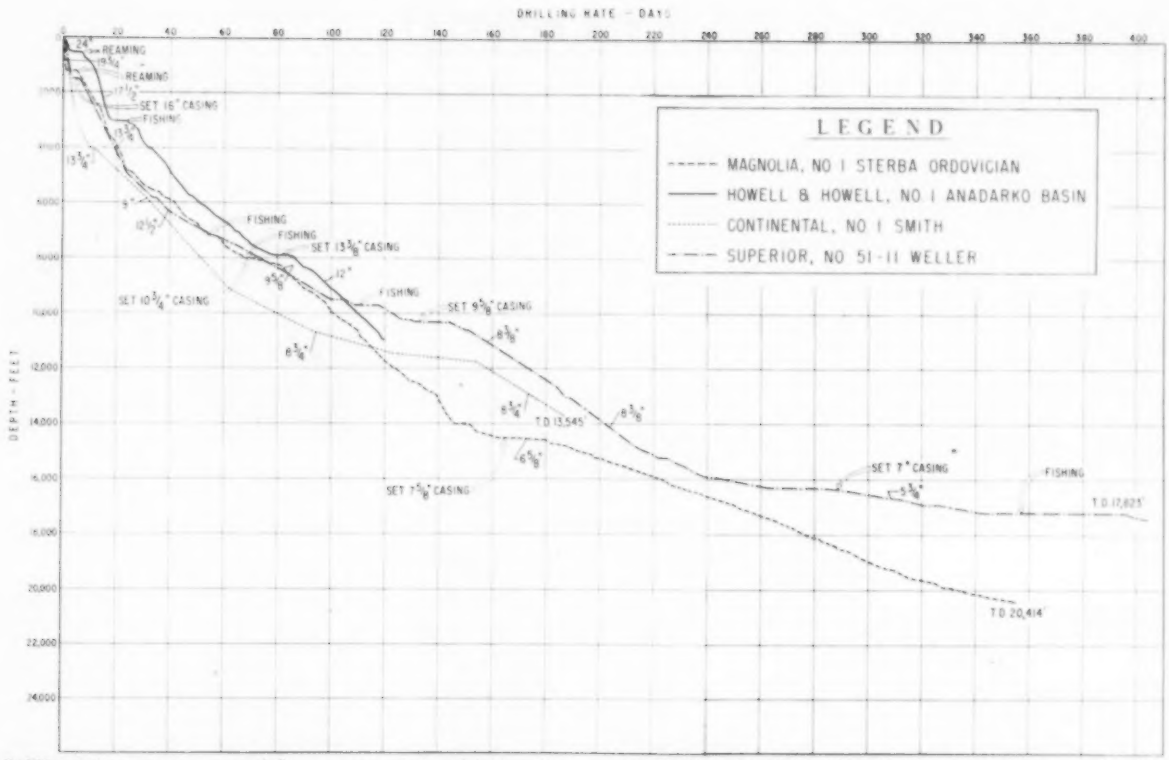
Personnel of Shell Oil Company's Production Technical Services Division are presently experimenting with designs of hull shapes for the floating vessels. One design, the "doughnut," is circular in shape with a hole in the center. The upper section of the platform is equipped with a "pad" for helicopter landing, automatic pipe rack, drawworks and other drill equipment. In the lower section of the unit are located mud storage, pumps, power equipment and living quarters.

A model of the "doughnut" is being tested at the University of California and appears to hold considerable promise for more successful deep water drilling due to its being less vulnerable to wave action and relatively economical to build.

Shell Production Technical Services Division personnel, B. H. Brown, left, and B. G. Collipp, examine a sectional model of the experimental "doughnut" drilling vessel being studied for deep-water drilling.

Hermosa Beach Rejects Offshore Drilling

In a special election held February 25, citizens of Hermosa Beach, California, sustained the city's 20-year-old ban on oil drilling; 1815 were in favor of rescinding the ban, 2325 were opposed. Shell and Continental Oil companies had previously signed a contract with the city council for the right to drill in the city's submerged lands and use of a tract of city property for operational headquarters and separation center, subject to the voters' approval.



Drilling rate curves compare drilling progress of Howell & Howell's Anadarko Basin No. 1 with three other deep wells which have been drilled in the same general area. Curve shows the Anadarko Basin well at 10,991 ft on March 10, 1958. The Magnolia well was completed in November 1957, Continental's well was completed in January 1953, and the Superior deep well was completed in August 1947.

WORLD DEPTH RECORD CONTENDER DRILLING AHEAD

IN LAST MONTH'S ISSUE, *The Petroleum Engineer* published a complete report on the planning of a super-deep well presently drilling in Oklahoma. The well is Howell & Howell's Anadarko Basin No. 1, one of the most ambitious drilling projects being undertaken in the industry today.

Many new and special problems had to be considered in planning to drill this well. Before the well was spudded in on November 10, 1957, many months of studies and calculations had been made in planning the detailed drilling program which would carry the well to a depth of 24,000 ft. The giant power rig selected for the job was specially equipped to provide maximum assurance of success in this deep well venture.

First drilling in the well was a 24-in. hole to 540 ft. A string of 20-in. OD, 72.16 lb-per-ft line pipe was run and cemented to the surface.

Drilling then continued with a 17½-in. hole to a depth of 7903 ft, a record depth for hole of this size. Studies had shown that there was no standard casing available which would be adequate for casing the 17½-in. hole, and a string of special-order casing had therefore been provided for the job. The casing was 13⅜-in. OD, N-80, weighing 85 lb per ft, with a wall thickness of 0.608 in.

Cementing the 7898 ft of 13⅜-in. casing involved one of the biggest cementing jobs ever performed. Four pump trucks were used to mix cement from 15 storage bins and bulk-cement trucks carrying a total of 6100 sacks of cement. The first batch consisted of 100 sacks of slow-setting cement with 2 percent gel, and was followed by 5000 sacks of portland cement with 12 percent gel, retarder, and ⅛ lb-per-sack shredded cellophane. Another batch of 200 sacks of slow-setting cement was then pumped.

After a temperature survey located the top of the cement at approximately 1825 ft, 1500 sacks of cement were pumped through 1-in. tubing down the annulus to complete the cementing of the 13⅜-in. string to the surface.

After the successful cementing job was completed, drilling was resumed with 12-in. hole which is tentatively scheduled to go to 19,000 ft. Drilling of this hole has progressed without incident and on March 11, passed 11,000 ft.

Two different types of three-cone roller bits have been used in drilling the 12-in. hole. One is designed for drilling "hard" formations and the other is designated for drilling "medium hard" formations. In addition, both types of bits have been used with and without jet nozzles.

Mud Program. The main modification in the mud program since starting the 12-in. hole has been the addition of approximately 10 percent diesel oil to the mud, resulting in a definite increase in penetration rate. It is expected that more oil may be added to the mud to raise the content to approximately 12 percent.

The drilling report dated March 10, 1958, showed the following characteristics of the mud being used in drilling the 12-in. hole: Mud weight, 11.2 lb per gal; viscosity, 66 sec; water loss, 4.5 cc; pH, 9.7; chloride content, 1600 ppm; oil content, 9.9 percent. Mud weight will be increased slightly at around 12,000 ft in anticipation of encountering gas zones. It is expected, however, that unless temperatures become excessively high, this simple water-base mud will be adequate for drilling to total depth.

Mud pumps are being operated with 5½-in. liners at around 52 strokes per min to provide a circulating pressure of approximately 1800 psi. Weight on the bit has been held at around 83,000 lb and a deviation survey on March 10 showed only ¾ deg hole deviation.

RUNNING TOUR with MEN in the INDUSTRY

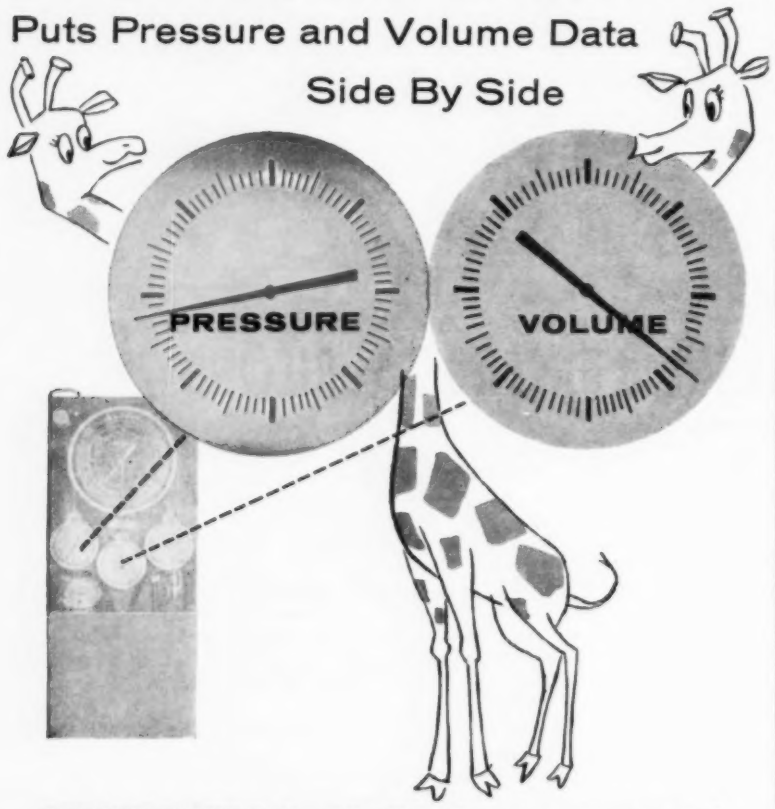
▸ **A. M. Orr,** who has been district superintendent for the Scott & Hopper district in the Southwest Texas division for the past 10 years has been transferred to the Imogene district as district superintendent for Humble Oil & Refining Company. He replaces **A. B. Vanhooser** who is retiring. **Frank Bass,** district superintendent for the Kelsey district, will assume direction of the Scott & Hopper district. **J. E. Cox,** district superintendent of the Castaic Junction district in California for five years has been transferred to the Bakersfield district in California. Cox was replaced by **J. F. Jeansonne,** who had been district superintendent at Bakersfield for two years.

▸ **C. F. Dohm** has been elected president and director of Pan American International Oil Company.

Pan American International, a newly formed subsidiary of Pan American Petroleum Corporation, has been organized to carry out oil exploration and development operations in the Eastern Hemisphere. Its principal offices will be located in New York City with at least one branch office to be established in Europe. Pan American Petroleum is the wholly-owned producing subsidiary of Standard Oil Company (Indiana). Dohm was formerly president and director of Conorada Petroleum Corporation, a subsidiary of Continental Oil Co., The Ohio Oil Co., and Amerada Petroleum Corp.

It Takes Two – Only MARTIN-DECKER

Puts Pressure and Volume Data Side By Side



MARTIN-DECKER Combination Pressure Gauges and Volume Indicators Tell the Complete Hydraulic Story

Two gauges are necessary, but two heads are not. Mud Pressure by itself does not tell the whole story. Both pressure and volume are needed. A pressure drop indicates trouble but is it a clue to a cut-out bit or tool joint, or is it a pump slowing down?

Hydraulics are becoming the most important single factor in drilling wells. The driller must know what his pumps are doing in order to: protect his equipment, follow his hydraulic program and quickly note any troubles so that prompt action can prevent serious damage. Only with both pressure and volume information can you know the complete story of your hydraulic system.

MARTIN-DECKER CORP.
HOME OF THE WEIGHT INDICATOR — LONG BEACH, CALIFORNIA

B-152

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▸ **J. R. Brady** has joined Northern Natural Gas Company as reserves engineer in the reserves and availability section of the gas supply department. He was associated with American Louisiana Pipe Line Company, Detroit, Michigan, for two years before joining Northern and was with Michigan Consolidated Gas Company, Detroit, Michigan, before joining American Louisiana. Both companies are subsidiaries of American Natural Gas Co.

J. R. Brady

L. W. MacNaughton

▸ **L. W. MacNaughton** has been named to Dresser Industries, Inc.'s board of directors. MacNaughton is board chairman for the consulting firm of DeGolyer and MacNaughton.

▸ **Richard W. Scott** has been elected vice president of Republic Natural Gas Company. Scott has been associated during the past 10 years with Warren Petroleum Corp. as manager of exploration.

▸ **W. F. Bates** has been named area production manager for Shell Oil Company's west of the Rockies operation. **B. P. Eastin,** whom Bates will replace, has been appointed manager of production research for Shell Development Company's exploration and production research division in Houston, Texas. Bates, until his recent promotion, has been assistant to Shell's Pacific Coast area vice president.

▸ **T. F. Palmer,** assistant division manager of the Houston division of Sinclair Oil & Gas Company, has been elected a vice president of the company and named Houston division manager. Palmer succeeds **G. D. Almen Jr.,** vice president, who is being transferred to Midland, Texas, as Midland division manager. Almen replaces **Floyd Brett,** vice president, who goes to the Tulsa division. **R. M. Kobdish,** assistant manager of the Tulsa division, will be transferred to Houston as assistant division manager to succeed Palmer.

Paul E. Fiebig, senior landman for Sinclair at Amarillo, Texas, has been promoted to district landman in charge of Sinclair's Amarillo office. He succeeds **L. M. Oles,** who has taken a leave and who will retire this year.

Roy E. Dosser, executive assistant in the Jackson, Mississippi, division for Sinclair Oil & Gas, has been named Jackson division manager. He succeeds **J. F. Snyder,** vice president and division manager, who has taken a leave of absence and who will retire this year. **Gene O. Davis,** Jackson division geologist, becomes assistant division manager at Jackson.

Roy C. Williamson, assistant manager of the Fort Worth, Texas, division for Sinclair O&G, has been named Fort Worth division manager. He succeeds **P. C. Brooke,** vice president and division manager, who has taken a leave of absence and who retires this year. **M. H. Lowrance,** exploration superintendent of the Fort Worth division, becomes assistant division manager succeeding Williamson. **D. A. Jerome,** staff landman for the Houston division, becomes exploration superintendent of the Fort Worth division succeeding Lowrance.

Running Tour

J. A. Warke has been appointed assistant coordinator of joint operations, Mobil Oil of Canada, Ltd. Succeeding Warke as district operations superintendent in Calgary will be **A. A. Halkers. S. M. Thorne** has been named district operations superintendent for Mobil Oil of Canada in Edmonton. Warke joined the company in 1952, and has been a district superintendent in both Edmonton and Calgary.

J. A. Warke

P. R. Waddle

Paul R. Waddle, southern division reservoir engineer for Carter Oil Company, has resigned and opened offices as a consulting petroleum engineer in Shreveport, Louisiana. He will specialize in reservoir performance studies, oil and gas reserves calculation, and evaluation of oil and gas properties.

Herman J. Schmidt, general counsel, and **Fred H. Wilcox,** manager of the producing department, were elected to the board of Socony Mobil Oil Company, Inc. Wilcox is a graduate of the School of Mines of the University of Minnesota. Schmidt attended the University of Iowa, and Harvard Law School.

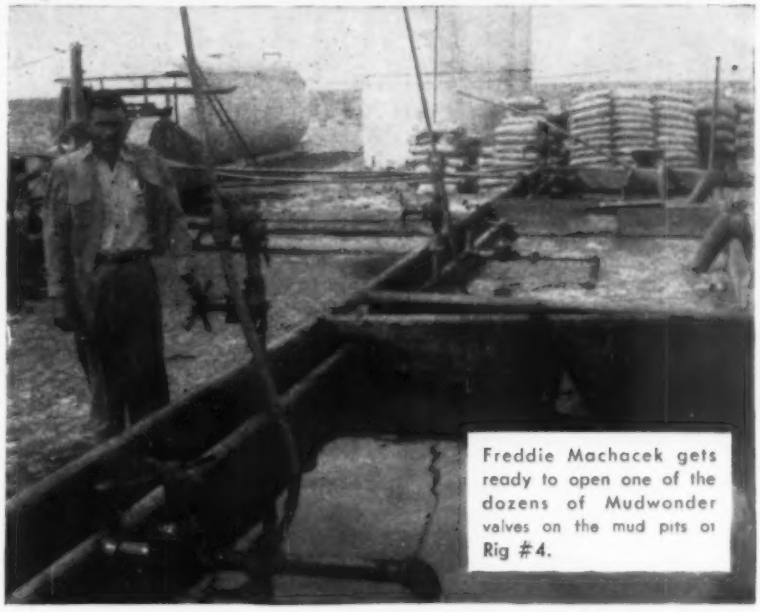
Perry E. Barnhart has been appointed district geologist for Cities Service Oil Company in its Lafayette, Louisiana, district and **Bill James** has been named to succeed Barnhart as district geologist at Midland, Texas. Barnhart succeeds **B. C. McCasland,** who has accepted an assignment with a Cities Service foreign subsidiary.

John D. Moody, formerly district manager of the Midland district of Gulf Oil Corporation's Fort Worth production division, has been transferred to Pittsburgh as an exploration advisor. He joins **Louis C. Sass** and **Dr. Wendell B. Gealy** as exploration advisors to **Dr. Hollis D. Hedberg,** vice president of exploration for the company.

Latin America division offices for Sun Oil Company's foreign operations department, formerly located in the Rio Grande Building in Dallas, have been moved to Caracas, Venezuela. Involved in the move are **B. E. Warren,** division manager; **P. W. McFarland,** division chief geologist; **Lee C. Smith,** division assistant chief geologist; **John Waller,** district geophysicist, and members of their staffs. Sun opened offices in Caracas and other Central and South American cities when it organized its foreign operations department in 1956, with **Ted C. Stauffer** of Philadelphia as director, but these Latin America division officials continued to maintain offices in Dallas until the current move. The new address is Sun Oil Company, Apartado 4523 del Este, Caracas, Venezuela.

Ben R. Howard has joined Republic Natural Gas Company as chief geophysicist. Howard entered his field as geophysicist with Socony-Vacuum in Venezuela, and later was employed by the Warren Petroleum Corporation, where he became chief geophysicist.

Tips on Mud Valves for Toolpushers . .



Freddie Machacek gets ready to open one of the dozens of Mudwonder valves on the mud pits on Rig #4.

MUDWONDER Ideal for Versatile Service

by Freddie Machacek, Toolpusher, Rig #4
B.B.M. Drilling Company, Midland, Texas

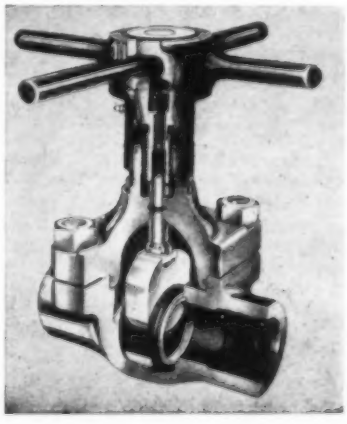
ABOUT two years ago I put a *Mudwonder* valve on our fill-up line just to see how it would make out. I soon found that *Mudwonder* worked fast and easily, without binding, even while bleeding off the line at 1600 lbs pressure. It did so well I tried more *Mudwonders* on the tough job of mud pit service—and they were so successful I've standardized on *Mudwonder* ever since!

Valves on mud guns and jets take a terrific beating, but we've had very little trouble with *Mudwonders.* As a matter of fact, our first ones are still in service; we replaced the stem packing on one valve—that's all! Because replacement parts are so easy to identify, we never have any trouble getting the exact part we need. In fact, the valves are designed to use the same seat and gate for both pressure classes.

When we have to dress a *Mudwonder,* the job can be done without disturbing any connections. The valve is out of service only about 10 minutes, start to finish, regardless of size. Another thing—they never sand up. Bob Lawrence, Edward *Mudwonder* Representative, says this is because the design causes the mud to flush the bonnet automatically.

Mudwonder valves are available in 2", 3" and 4" sizes; with screwed or flanged ends; rated at 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test). See your favorite oil field supply store for complete information, or write Edward Valves, Inc., East Chicago, Indiana, subsidiary of Rockwell Manufacturing Company.

Mudwonder cut-away view shows the one-piece seat insert, with Buna-N molded integrally over steel wear rings; chromed gate with "T" slot connection; separated stainless stem and double thread construction.



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The IVERSON SUPPLY COMPANY can serve your tubular goods requirements quickly and efficiently from strategically located terminal stocks.

A complete stock of tubular goods is maintained at all times, ready for immediate shipment to your job location. Check your weekly "Pipe"* list provided by the Iverson Supply Company, for stocks on hand at the Terminal locations.

* If you would like to receive the weekly "Pipe" stock list, please contact your nearest Iverson store or write to Tulsa general offices.

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TEXAS — Kermit, Odessa, Snyder.
COLORADO — Cortez

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IVERSON SUPPLY COMPANY
DRILLING-PRODUCTION AND REFINERY EQUIPMENT
GENERAL OFFICES
P. O. BOX 1439 TULSA 1, OKLA.

OFFICES: DENVER, COLORADO TULSA, OKLAHOMA

Running Tour

▸ **Kenneth E. Chaffin** has been made general superintendent of the Louisiana-South Texas division of Loffland Brothers Company, Tulsa, succeeding George C. Mallory, deceased. **D. E. Williams** has been promoted to assistant general superintendent of the Louisiana-South Texas division. Both Chaffin and Williams will make their headquarters in the company offices in New Iberia, Louisiana.

Paul L. Waid has been made assistant superintendent of operations of Loffland Brothers Company of Canada. He will make his headquarters in the offices of Loffland Brothers Company of Canada, in Calgary, Alberta.

▸ Monterey Oil Company announces the appointment of **Donlin P. Murdy** as vice president for finance and **Albert W. (Bob) Gentry** as vice president for operations. Murdy and Gentry have been promoted from assistant to the president and manager of field operations, respectively.

▸ **T. L. Owen,** a veteran of more than 26 years in drilling, has been promoted from toolpusher to superintendent of the land drilling division of Rimrock Tidelands, Inc. The appointment of **G. D. Murray** to superintendent of the marine drilling division was also announced. He will be in charge of Rimrock's four offshore drilling rigs now operating in the Gulf of Mexico, as well as the company's two new barge mounted rigs which will begin operations later this year.

▸ **William C. Elliott Jr.,** formerly assistant chief of the Dallas offices of the Bureau of Mines, has been transferred to Wichita Falls where he will be chief of that office. Elliott is a graduate of the University of Oklahoma where he majored in petroleum engineering.

▸ **Michael J. Boyce,** superintendent of the Casper production division, Ohio Oil Company, has retired. He is succeeded by **H. J. Brunt,** assistant division superintendent.

▸ **J. B. Storey** of United Gas Pipeline Company, has been elected a director of Union Producing Company, production subsidiary of United Gas. He was transferred to Shreveport on January 15 to assist in various production operations of the company. Story has been manager of the New Orleans district of United Gas and Union Producing since 1950. **R. G. Bryan,** assistant manager of the New Orleans district since 1956, will succeed Storey as district manager there.

▸ **Paul V. Baker** has been named safety director for the Garvey Drilling Company. Baker was formerly associated with Continental Oil Company for the past 12 years. He resigned his position as administrative assistant to their safety division in November to assume his new duties with Garvey Drilling.

▸ **William S. (Bill) Shropshire** has joined Falcon Seaboard Drilling Company as production engineer over Texas operations. Shropshire was formerly district superintendent for Warren Petroleum Corporation at Big Spring, Texas. He now headquarters at the company's offices in Houston.

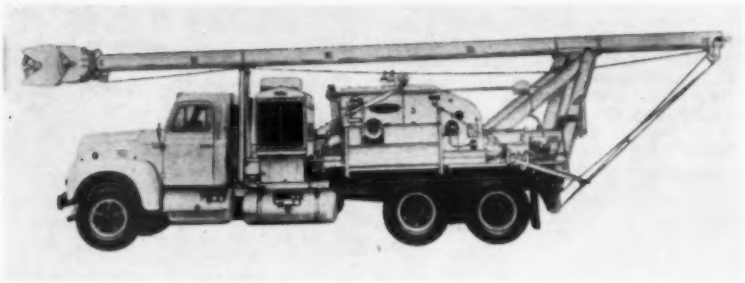
▸ **John R. Van Slyke** has announced the opening of offices at 913 Central Building, Wichita, Kansas, as consulting petroleum engineer, specializing in oil producing problems, property evaluations, reserve estimates, secondary recovery operations, and unitization procedures. He has been employed by Barnett Oil Company for the past 6½ years.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

It's New

Drilling – Producing Equipment

Light Workover and Shallow Drilling Rig



Introduction of a new unit capable of doing servicing or workover to 5000 ft, cable tool workover to 4000 ft and rotary drilling to 2500 ft with 3½-in. drill pipe has been announced by Cardwell Manufacturing Company. The new unit has an input rating of 120 hp. The basic unit is designed with cross members for trailer or truck mounting.

The unit is known as Model A-150 and A-151. The A-150 model is an engine powered unit and the A-151 model is driven by the truck engine.

Main drum of the unit is free wheeling, smooth tube construction of laminated steel, double plate construction, with a spooling capacity of 4730 ft of ¾-in. cable. Brake flanges are heat-treated alloy steel and splash water cooled. Two self-energizing brakes with equalizing single point adjustments are used.

Sandline drum is also free wheeling, smooth tube construction, with a maximum spooling capacity of 11,000 ft of ½-in. line. Drum shaft is prepared for cathead mounting if desired. A single spool cathead, rope splitter and catline guide rollers have been installed on the operator's side of the unit.

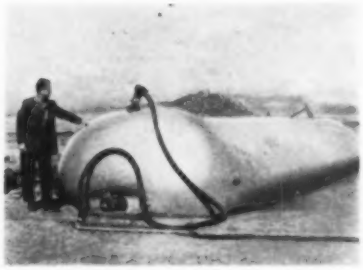
Standard equipment on the unit includes a complete air system and controls for drum clutches and engine clutch. Also included are engine throttle, with foot and hand controls at operator and sand drum positions. Sand drum control operated is at skid level, near the sand drum — except with spudding attachment. Steel dividers are available with both drums. *Cardwell Manufacturing Company.*

Circle number (1) on reply card.

Collapsible Rubber Tank

Lightweight rubberized fabric tanks of 15,000 gal capacity that are completely collapsible are being adopted in the oil fields of the southwest to save costs and improve efficiency of operations.

The tanks, called "whales" because of their size and shape, can be rolled up into a package 8 ft long by 2½ ft in diameter and weigh only about 1/10 as much as a steel tank with a comparable capacity.

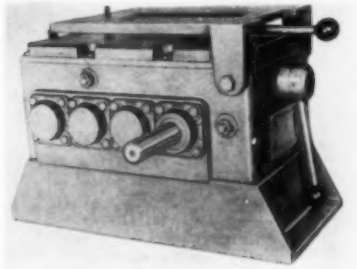


When filled to capacity, the tanks are 47 ft long, 11 ft wide and 5 ft high. They are constructed of 2 plies of nylon fabric coated with a special Neoprene compound designed to protect the tanks against abrasion and atmospheric conditions. *The Firestone Tire & Rubber Company.*

Circle number (4) on reply card.

Multi-Speed Transmissions

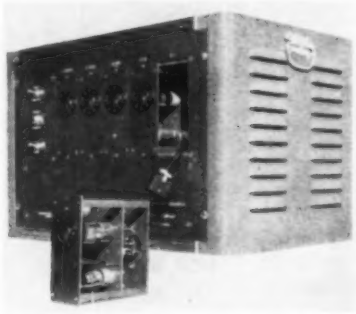
Turner Uni-Drive is offering models 240 and 540 transmissions, with selective gears in 4, 6, and 9 ranges of speed. Standard high to low output ratios vary from 4.7:1 to 8:1, with maximum 12.4:1 step-down.



Flexibility of arrangement is provided by types of accessory mounts. In one with attached rigid base, a top-hinged motor plate allows belt adjustment; in another with H-beam base, transmission and motor are mounted horizontally, and motor rails allow for belt take-up. *Turner Uni-Drive Company.*

Circle number (2) on reply card.

Remote Reading Counter



Totals on widely separated electrically or mechanically driven counters may be read remotely without destroying or changing the readings on the counters. This is one of the features of the new McEvoy Remote Reading Counter. The counter permits its operator to gather at one central point up-to-the-second readings from any number of distant counters, regardless of the number of digits on each counter. *McEvoy Company.*

Circle number (3) on reply card.

Density Measurement System

An AccuRay density system which measures and/or controls fluid density, specific gravity, percent solids, or related quantity has been announced by Industrial Nucleonics. This density unit is applicable to liquids, slurries, and flaked, granulated, powdered, or other divided solids. Based on the principles of gamma-ray transmission from a radioisotope, the system makes no physical contact with the flowing material. Measurements are independent of flow rate and pressure.

Depending upon the process and material measured, long term accuracies of ±0.001 to ±0.003 specific gravity are readily obtainable. The instrument may be located hundreds of feet from measuring head. *Industrial Nucleonics Corporation.*

Circle number (5) on reply card.

Insulated Line Union

A new insulated union that has the insulation locked in place to prevent its loss during make-up or while in transit has been developed by Well Equipment Manufacturing Corporation.

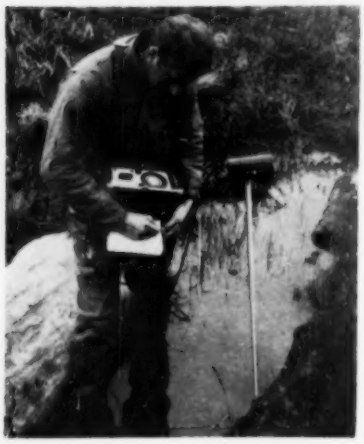
The union has been tested to more than 35 million ohms resistance and is manufactured in sizes from 1 to 4 in. for pressures up to 2000 lb. *Well Equipment Manufacturing Company.*

Circle number (6) on reply card.

New Equipment

One-Man Magnetometer

One of the latest tools for geologists and geophysicists is Varian Associates' M-49, a new 1-man portable magnetometer. The unit measures the total intensity of the earth's magnetic field. Because it can detect changes in the field, caused by varying sub-surface geological structures and mineral deposits, it has many applications to prospecting. It is said to be as easy to operate as a radio and accurate under the most rugged conditions.



Weighing only 16 lb, the unit is battery powered permitting operation in remote areas and eliminating problems associated with differing world-wide line voltages and frequencies. *Varian Associates.*

Circle number (7) on reply card.

High Pressure Tubing

Grayloc tubing, a specialty oil country product capable of withstanding the conditions found in the highest pressure wells, is being made by Jones & Laughlin Steel Corporation. The tubing features a high-pressure seal which has previously been used extensively for connections on wellhead equipment.

The leakproof seal is achieved by means of an independent seal ring which is so designed that when the tubing joint is made up, the stored energy in the stressed seal ring provides the primary sealing force that holds pressure. Under operating conditions, the internal fluid pressure acts to increase the seal's effectiveness. *Jones & Laughlin Steel Corporation.*

Circle number (8) on reply card.

Magnetic-Plunger-Lubricator Control System

A new well plunger-lubricator control system, featuring a magnetic trip mechanism, has been introduced by the Harold Brown Company. The magnetic tripping device eliminates the need for any openings, protrusions or movable seals into the lubricator.

With the system, a balanced magnetic circuit is interrupted when the plunger enters the lubricator. This triggers a pilot valve which closes the controller, shutting down the flow line motor valve instantly. *Harold Brown Company.*

Circle number (9) on reply card.

Rapid Log Duplicator

A new method for making extra copies of logs, charts and documents of special length has been introduced by the Duplicating Products division of Minnesota Mining and Manufacturing Company. The process — which can cut reproduction costs by as much as 70 percent and reduce copying time by 85 percent — involves a roll paper adapter for use with "Thermo-Fax" copying machines to permit continuous flow copying.

The unit is particularly suited for use by the oil industry for making exact copies of original seismographic records varying in widths up to 14 in. and almost any length. *Minnesota Mining and Manufacturing Company.*

Circle number (10) on reply card.

Metering Separator for Foaming Crude

A new metering separator for metering foaming crude oil has been developed by Oil Metering and Processing Equipment Corporation. The unit dump volume of oil in the separator is controlled by a hydrostatic head liquid level controller; therefore, this unit will dump the same amount of net stock tank oil each cycle, regardless of the foaminess of the oil.

The units are available in sizes from 1 bbl per dump up to 30 bbl per dump. They will handle from zero up to 50,000 bbl per day. A float operated liquid level indicator can be arranged to convert the unit to a standard float operated volume type metering unit. *Oil Metering and Processing Equipment Corporation.*

Circle number (11) on reply card.

Interlocking Steel Drums

A new 55-gal steel drum which interlocks with adjacent containers when any number is unitized or packed closely together, has been developed as a means of saving space and reducing handling and shipping costs.

The key to the interlocking feature is the special design of the rolling hoops. These are slightly offset — alternately raised and lowered — on opposite sides of the drum. When unitized, a group of the drums can be handled by a standard lift truck without the necessity of wood pallets. *Vulcan Containers, Inc.*

Circle number (12) on reply card.

YOU CAN'T FOOL AN OIL WELL

Most any dairy cow gives a better account of herself if she's milked by a well acquainted and experienced hand. Old Bossie just seems to know the difference.

Oil wells are the same way. Records prove that almost any oil well seems to be a more profitable producer if equipped with a JENSEN JACK.

If you would like your 1958 production to be more profitable . . . get the facts and figures on JENSEN JACKS . . . NOW!

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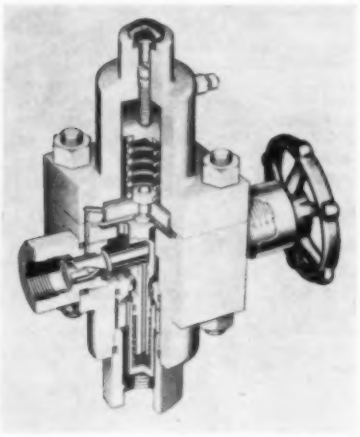
JENSEN JACKS

New Literature

Constant Flow Valve



Kobe, Inc. has issued an illustrated bulletin on the Kobe constant flow control valve which explains design, construction and performance characteristics. The diaphragm type, non-lubricated valve serves wherever pressure in a fluid line fluctuates. Working pressure is 5000 lb, flow rate is 45 gal per min. The desired rate of flow is set by the hand wheel. *Kobe, Inc.*

Circle number (13) on reply card.

Profits from Sour Gas

Tears Engineers, contract engineering firm, has issued a 4-page bulletin on its new sulfur recovery unit, a plant designed to convert H_2S (acid gas) to molten sulfur of high purity. The literature contains a large illustration of the unit and describes its design and applications.

The unit is completely shop-assembled for shipment and is ready to go onstream after connecting a supply of electric power and the acid gas. *Tears Engineers.*

Circle number (14) on reply card.

Wellhead Equipment Catalog

A new 24-page wellhead equipment catalog is announced by The National Supply Company. The complete line is presented, including pictures and sectional diagrams showing design features of parts and assemblies, specifications for each part, and steps of procedure for making a "triple-sealed" wellhead. *The National Supply Company.*

Circle number (15) on reply card.

Electric Tachometer Brochure

Recent technical improvements in Martin-Decker's line of electric tachometers are included in the newly revised brochure P-74. These self-energizing instruments are for the measurement of pump-stroke count, rotary table speed and engine rpm, and constitute a major improvement over the mechanical tachometers used by the drilling industry for many years.

Recording is possible on a single, double or 4-channel electric recorder. *Martin-Decker Corporation.*

Circle number (16) on reply card.

Glassed Centrifugal Pumps

A new 16-page booklet on the glassed centrifugal pump has been jointly issued by Goulds Pumps, Inc. Included is a history of the development of the pump and answers to over 30 questions about the pump by chemical and process engineers. *Goulds Pumps, Inc.*

Circle number (17) on reply card.

Simple Drilling Control

A new 4-page, illustrated bulletin explains how General Electric's oil well drilling drive systems with simplified controls provide lower cost per ft of hole, less rig maintenance, better drilling control, more rig portability, and improved drilling protection. *General Electric Company.*

Circle number (18) on reply card.

SECONDARY RECOVERY
Since 1922

PETROLEUM ENGINEERS
CABLE ENGINEERING
WICHITA FALLS, TEXAS

RESERVOIR ENGINEERING
Water Flooding — Gas Repressuring
EVALUATION — CORE ANALYSIS
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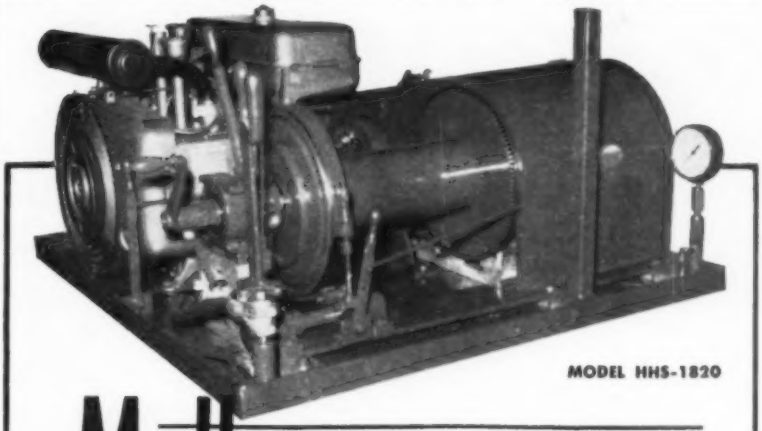

MODEL HHS-1820

Mathey MEASURING LINE REELS

The Oil Industry's First Name in Reeling Equipment
"Never a Compromise in Quality"

USES:
- Bottom Hole Pressures
- Temperature Surveys
- Calipering
- Paraffin Cutting
- Sampling
- And Many Other Wire Line Jobs

Mathey Reels are available in many sizes with various drives and controls in combinations to completely meet every requirement. Choose your type of control — hydraulic or mechanical, your capacity, your line speed and pull, and your type of power—hydraulic air, electric or internal combustion engine.

Mathey's many years of experience guarantee you extra heavy duty construction, precision machining, oversize bearings and forged steel drum flanges. Mathey also engineers and manufactures specialty reels to fit your individual requirements.

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New Literature

Spectrophotometer Accessories

A new catalog of sampling equipment and other accessories for the Beckman IR-4 infrared spectrophotometer is now available from the Beckman/Scientific Instruments Division. The catalog lists and describes applications for large-volume and micro sampling cells for liquids, gases, and solids. *Beckman/Scientific Division.*

Circle number (19) on reply card.

Chloride-Free Paraffin Remover

An illustrated brochure is available which describes SOLVO, new paraffin removers that are free of organic chlorides, developed by the Tretolite Company Divisions of Petrolite Corporation.

The paraffin removers are organic liquids, most of which are dispersible in both oil and water and can therefore be used in either diluent. *Tretolite Company.*

Circle number (20) on reply card.

Six "Timing" Catalogs in One

A new "Timing" belt drive catalog announced by Morse Chain Company makes available information on all 5 basic "Timing" belt pitches. In addition to engineering information, the catalog covers the following pitches: ⅛ in., ⅜ in., ½ in., ⅞ in., and 1¼ in. It contains complete information on selection, installation, and use of the drives. *Morse Chain Company.*

Circle number (21) on reply card.

Access to Pressure Equipment

A fully illustrated catalog of access fittings for oil wells, pipelines, refineries and industries requiring means of entry into equipment under pressure has been published by COSASCO Division, Perfect Circle Corporation. The 32-page catalog shows cutaway views and tabulations of sizes and types of the fittings for all applications. Detailed data are presented on fittings for obtaining pressure readings and those that permit valve removal or replacement without system shutdown. *COSASCO Division, Perfect Circle Corporation.*

Circle number (22) on reply card.

Demolition Tool Bulletin

Ingersoll-Rand has published a new 24-page bulletin entitled "Accessories for Demolition and Digging Tools" to serve as a comprehensive catalog of the company's complete line of digging tools and accessories.

The bulletin includes a useful page on reforging, sharpening, and the proper method of hardening these tools. A special section tells about safety tools of forged beryllium copper to be used where sparks can't be tolerated. *Ingersoll-Rand Company.*

Circle number (23) on reply card.

Seals for Rotary Shafts

A new booklet describing the principle of retaining gases, oils or other liquids under pressure has been published by the Rotary Seal Division, Muskegon Piston Ring Company.

Titled "Solving the Problem of Seals for Rotary Shafts," the booklet's 12-page text is supplemented by photographs and line drawings, including a cellophane overlay showing solutions to typical sealing problems encountered in modern machine design. *Rotary Seal Division, Muskegon Piston Ring Company.*

Circle number (24) on reply card.

Wire Rope Troubles Bulletin

Leschen Wire Rope Division, H. K. Porter Company, Inc. announces a new illustrated 4-page folder on the subject of "crushing" as a common hazard to wire rope. All of the major causes of crushing are described and the folder provides many suggestions for recognizing the source of wire rope troubles and for lessening or eliminating them altogether. *Leschen Wire Rope Division, H. K. Porter Company, Inc.*

Circle number (25) on reply card.

Explosion-Proof Housings

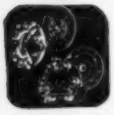
The Adalet Manufacturing Company has combined into a 16-page bulletin selection and specification data for their line of cast-aluminum weatherproof and explosion-proof housings. For each housing listed, all photographic, dimensional and written data are gathered in one spot. In addition, a full complement of explosion-proof sealing fittings is shown for the more important needs. *The Adalet Manufacturing Company.*

Circle number (26) on reply card.

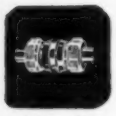
ROCKFORD

LONG LIFE
Heavy-Duty
POWER
TAKE-
OFF

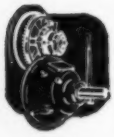
ELIMINATES
OUT-BOARD BEARINGS
AND COUPLINGS


Small Spring Loaded

Heavy Duty Spring Loaded


Oil or Dry Multiple Disc

Heavy Duty Over Center


Power Take-Offs

Speed Reducers

The heavy-duty construction of ROCKFORD Oil Field type POWER TAKE-OFF bearing assemblies will handle side loads that formerly required the use of out-board bearings—with hangers and flexible couplings. Shaft deflection is no problem with this extra heavy-duty power take-off—when the load is held within specifications. You can reduce the over-all length of the engine and power take-off assembly by specifying ROCKFORD.

SEND FOR THIS HANDY BULLETIN
Gives dimensions, capacity tables and complete specifications. Suggests typical applications.

ROCKFORD Clutch Division BORG-WARNER
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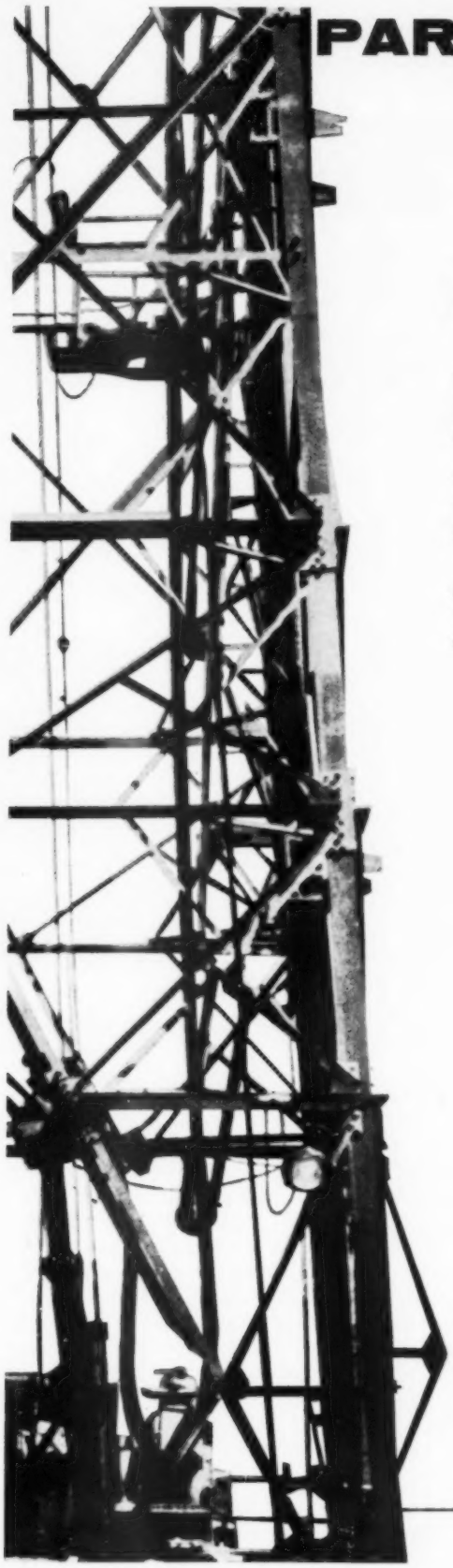
CLUTCHES



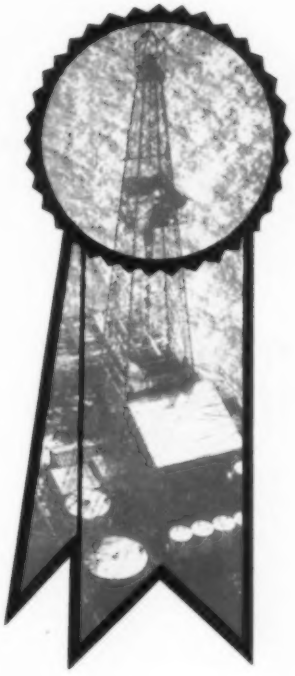
PARKERSBURG *Galemaster*

DERRICK OF DISTINCTION

The outstanding derrick in any drilling field is the Parkersburg Galemaster. The reason is simple . . . there just isn't another derrick equal to the Galemaster.

And Parkersburg Galemasters are rugged. Time and again a Galemaster has withstood winds of hurricane force. When other derricks were leveled, Parkersburg Galemasters remained erect.

Give your crews and your equipment the added protection of a Parkersburg Galemaster Derrick. The Galemaster is backed by almost 60 years of experience in derrick design and fabrication.



The **PARKERSBURG**
RIG & REEL COMPANY
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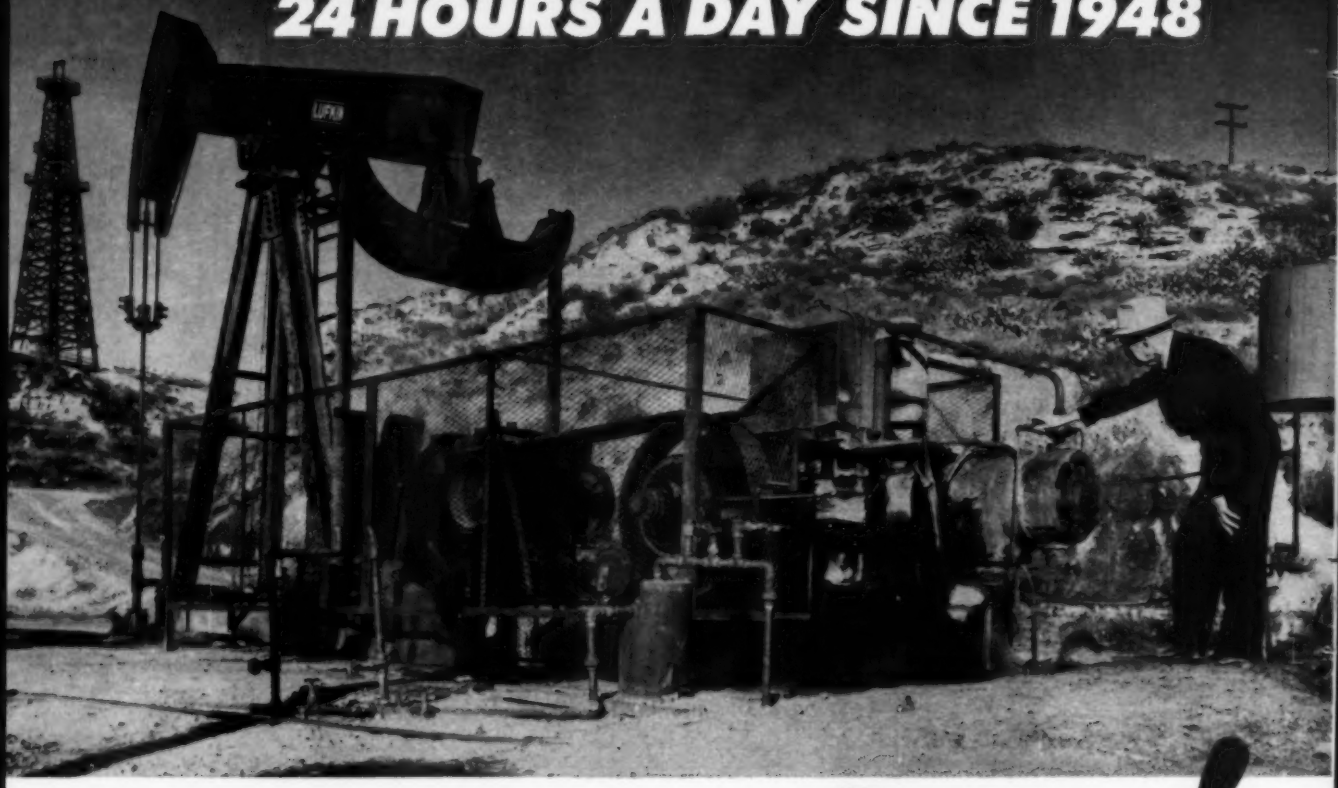
for instance

This *Ajax* CM-11x14 has been running 24 HOURS A DAY SINCE 1948



UNUSUAL? NO—JUST *Ajax!*

This is a typical AJAX workhorse on the job . . . steady, faithful, productive, making a lifelong habit of continuous daily service. Since beginning operation in 1948, the cylinder head has never been removed from the engine. • The facts are, AJAX Gas Engines work for less for longer, and they ought to be working for you. Your Supply Man will be glad to help plan an Ajax program for your particular needs. Call him.

AJAX

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Builders of GAS AND OIL ENGINES, PRESSURE PUMPS, STEAM ENGINES

Oil Field Distributors: THE NATIONAL SUPPLY CO., PITTSBURGH, PA. • R. B. MOORE SUPPLY CO., BOLIVAR, N. Y. • BETHLEHEM SUPPLY CO., TULSA, OKLAHOMA

AGAIN—Blaw-Knox points the way

. . . this time to ASHLAND's 6,000 bpd source of high octane gasoline

The catalytic reforming and hydrogen desulfurization unit, now in operation, is the latest of eight Blaw-Knox units which are operating successfully in the petroleum industry—to supply high octane gasoline for today's high compression motors. Engineered, constructed and installed by Blaw-Knox, it provides a capacity of 6,000 bpd in the Buffalo Refinery of the Frontier Oil Refining Division of Ashland Oil and Refining Company.

The wide experience of Blaw-Knox engineers in catalytic reforming, as well as other petroleum and chemical processes, is always available to you. We welcome the opportunity to discuss your proposed modernization, expansion or new plant projects with you—and to offer our recommendations.

BLAW-KNOX

BLAW-KNOX COMPANY

Chemical Plants Division • Pittsburgh 22, Pa. • Chicago 1, Ill.

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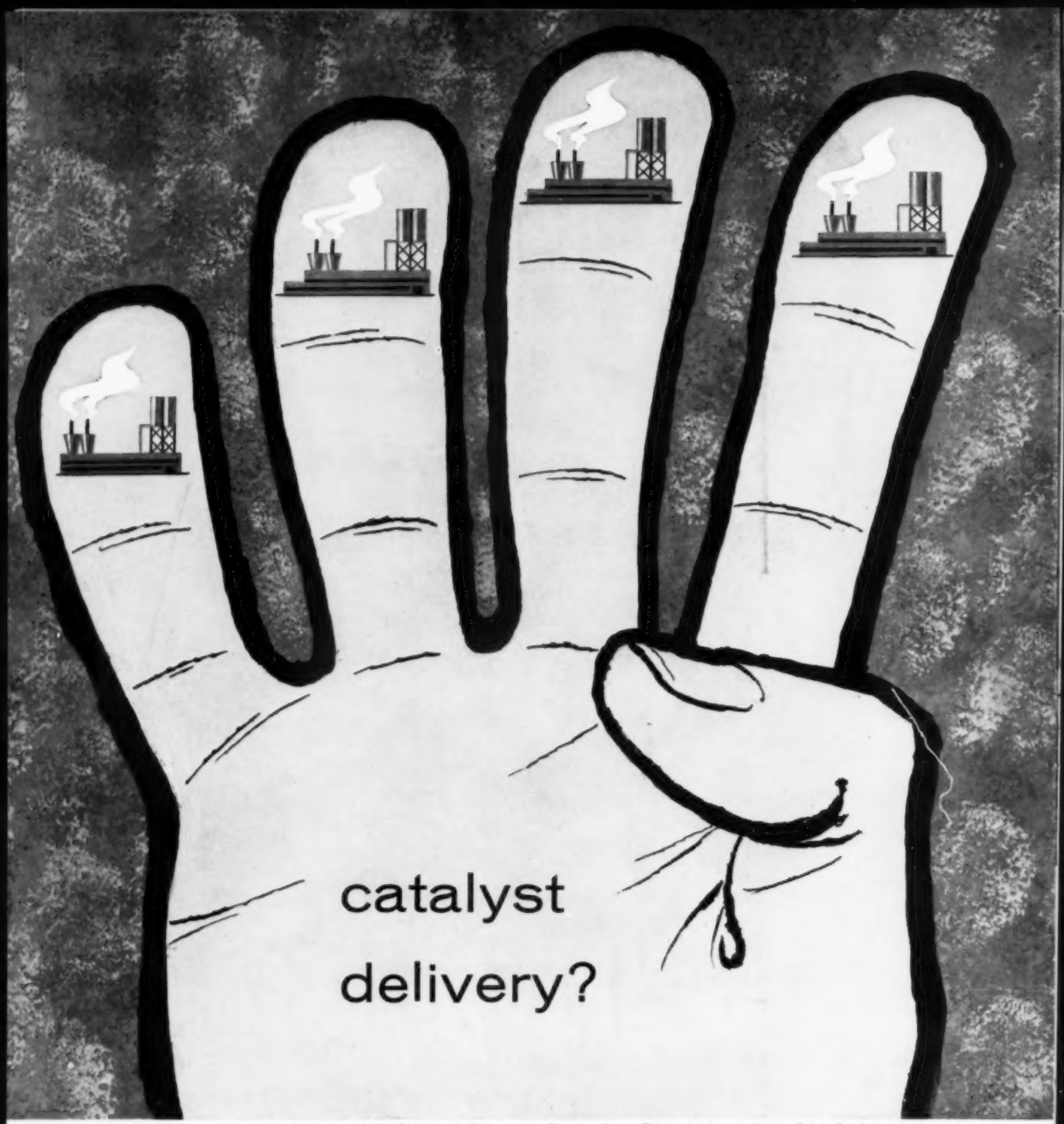


Davison catalyst plants are located in Baltimore, Md.; Cincinnati, Ohio; Lake Charles, La.; affiliated plant in Valleyfield, Quebec.

Four—count 'em—four catalyst plants back up Davison's claim of quick service

Fact: Davison has more plants producing petroleum catalyst than any other manufacturer. Fact: There is a Davison plant within easy shipping distance of most of the nation's refineries. Fact: Each plant is on main transportation arteries so shipments can be made by rail, truck, ship or barge. Conclusion: Davison delivers catalyst where—and *when*—you want it.

DAVISON
CHEMICAL COMPANY
Division of W. R. Grace & Co.
Baltimore 3, Maryland

Buy DAVISON—the quality catalyst backed up by experience, research, technical assistance, service!

New Projects in refining gas processing petrochemicals

Gulf Oil Corporation will soon begin construction of a 2000 bbl per day alkylation plant at their Toledo, Ohio, refinery. New facility will produce high octane blending stock. Using sulfuric acid as the catalyst, the plant will include a reactor section and four fractionating towers, one of which will be 140 ft high. M. W. Kellogg Company has been awarded the contract with completion scheduled for 1959.

Standard-Vacuum Oil Company has announced plans for an expansion program at their Altona, Australia, refinery. Contract has been awarded to Fluor International, S. A., to expand existing facilities and build a Sovafining unit. First phase of the project will boost refinery capacity by 9000 bbl per day. Second phase, to be started at a later date, calls for installation of the Sovafiner to improve diesel oil qualities. Both project are scheduled for completion in 1959.

A new aromatics plant, now under construction at the Buffalo, New York, refinery of Ashland Oil & Refining Company, is scheduled for completion by mid-April. Design of the 21-million gal per year unit makes it possible to produce benzene, toluene, xylene, and heavier aromatics. Company also has construction of additional facilities under study.

Esso Standard Societe Anonyme Francaise has awarded contract to Foster Wheeler Corporation for design and construction of refining and petrochemical manufacturing facilities at the Port Jerome, France, refinery. Expansion of a propane dewaxing unit, a new detergent alkylate plant, a petrochemicals plant, and lube oil additives plant are programmed. Chemicals plant will be designed to produce ethylene, butadiene, and other raw materials.

The Texas Company will build a 7500 bbl per day Udex unit at their Wilmington, California, refinery. Construction of the unit is to begin in May with completion scheduled for February 1959. High octane motor gasoline blending components will be produced.

Gulf Oil Corporation has entered into an agreement with Philippine Investment-Management Consultants, Inc. to form a petroleum refining and marketing company. New company, subject to approval of the Philippine Government, will build a 10,000 bbl per day refinery on the island of Luzon. The proposed refinery should be completed by late 1960.

ONSTREAM . . .

. . . **Esso Standard Oil Company's** 7200 bbl per day Powerforming unit at the Everett, Massachusetts, refinery. Unit uses platinum catalyst to upgrade naphthas to high octane gasoline. Unique feature of the unit is the "stilt" base—concrete pilings driven into the marshy land . . . the unit is built on the former site of a waste water separating pond.

. . . **a combination Platforming-Unifining unit,** including gas concentration facilities to produce LPG at Deutsche Erdol-Aktiengesellschaft's Heide, Germany, refinery. Unit will handle a blend of Heide-Arabian naphthas boiling in the 210 to 355 F range; 2000 bbl per day of 95 F-1 clear octane gasoline is produced with Unifiner serving as a preheater. Platformer will later be operated at 4000 bbl per day.

. . . **Japan's First Combination Platforming-Unifining** unit at the Yokohama refinery of Asia Oil Company, Ltd. With a design capacity of 1500 bbl per day, Platformer produces a 90 octane motor fuel blending component.

. . . **a hydrofluoric acid alkylation unit** at Champlin Oil and Refining Company's Enid, Oklahoma, refinery. The unit uses Phillips' process, is rated at 1430 bbl per day of motor fuel alkylate.

No Crude Oil Distillation at This Refinery!

Pontiac Eastern Corporation has put their unusual Black Creek Refinery — near Purvis, Mississippi — into full commercial operation. The $20-million plant processes 14,500 bbl per day of heavy, viscous crude and a field distillate gathered by Gulf Oil Corporation from South Mississippi fields.

Mississippi's first fuel products refinery includes an electrical desalter, Thermofor catalytic cracking unit, a 200 ton per day fluid coker, gas recovery, sulfuric acid alkylation, a 1500 bbl per day Unifiner and a 2500 bbl per day Platformer.

Refinery charge enters plant as two streams; one heavy, viscous crude and the other a field distillate stream. Crude is split by flash vaporization in a tar separator, with light ends going to the cat cracker and bottoms to the fluid coker. Field distillate is split into four streams by fractionation: Straight run gasoline for blending, heavy naphtha for Platformer charge, kerosine as a product and for blending, and bottoms added to the crude oil charge.

A unique central control house was built around a 108 ft long graphic panel board, from which the major units are controlled. This control center is located so that all units can be visually observed by operators.

Gasoline, accounting for 85 percent of refinery products, will be marketed by Gulf Oil Corporation in southeastern states. Refinery also will produce propane, butane, kerosine, diesel fuel, fluid coke, and sulfur. Plant has a design capacity of 27 tons of sulfur per day but is now operating at 17 tons per day.

←— Aerial view of the Black Creek refinery.

Measuring gas temperatures in an engine combustion chamber by radar. This technique depends upon the relationship between the velocity of sound in a gas and the temperature of the gas.

Ethyl Research Uses New Technique to Measure Combustion Temperatures

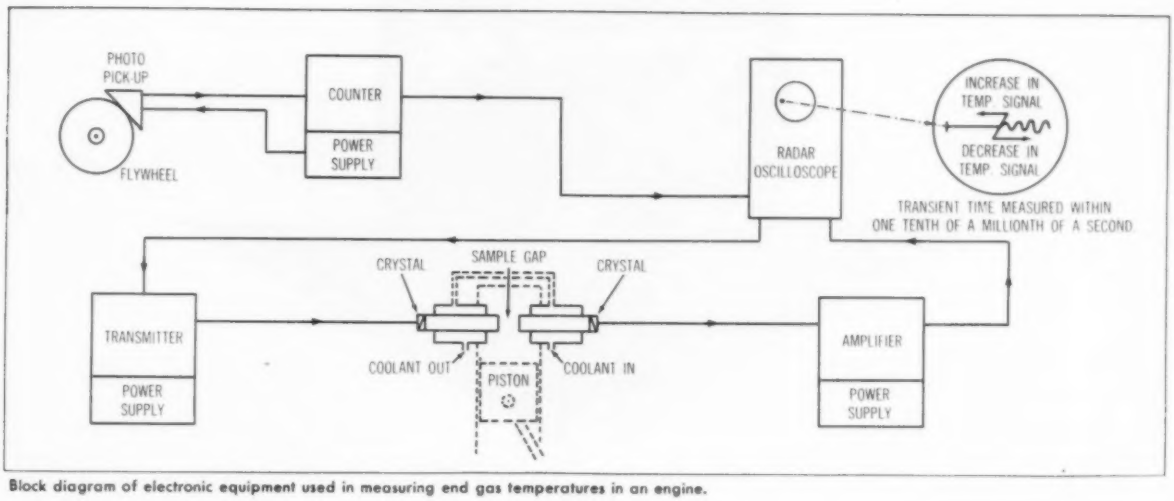
"Nearly all the grandest discoveries of science have been but the rewards of accurate measurements..."

—Sir William Thomson (Lord Kelvin), 1824-1907

Inability to measure the temperatures of the burning gases in an automotive engine has long impeded understanding of combustion phenomena.

Such measurements are a problem primarily because they involve time durations as short as millionths of a second. Even the most sensitive temperature-sensing devices generally are too slow for such work.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



Block diagram of electronic equipment used in measuring end gas temperatures in an engine.

Method Developed at Massachusetts Institute of Technology

Recently, scientists at the Massachusetts Institute of Technology, in a research program supported by the Coordinating Research Council and the Office of Ordnance Research, developed an ingenious solution to the problem.

The solution of the M.I.T. scientists is based on the classical thermodynamic relationship between the velocity of sound in a gas, the properties of the gas, and its temperature.

Calculations Check With Latest Theories

Ethyl Research, the first industrial laboratory to adopt this new method of temperature measurement, has found that the technique yields highly reproducible results.

Ethyl scientists also have determined that temperatures indirectly measured by the velocity of sound method check closely with calculations based on the latest theoretical concepts.

The mathematical expression of the relationship between temperature and the velocity of sound in a perfect gas is the equation

$$V^2 = \frac{Cp/CvRT}{M}$$

where **M** = molecular weight of the gas
Cv = specific heat of the gas at constant volume
Cp = specific heat at constant pressure
R = universal gas constant
V = velocity of sound in the gas at the absolute temperature, **T**

Since present knowledge of combustion provides answers for the specific heats and the molecular weight, measurement of the velocity of sound permits calculation of the gas temperature.

Radar Measures Sound Velocity

The M.I.T. method that was adopted by Ethyl Research people is to send a precise sound pulse—a 2,000,000-cycle-per-second vibration—from one side of the engine's combustion chamber to the other.

Then a radar oscilloscope and associated electronic equipment measure accurately the amount of time taken by the sound to cross the chamber.

Additional electronic equipment triggers the sound at any given instant in the engine cycle, thus permitting temperatures to be calculated throughout the cycle.

This new research tool opens the way to important new discoveries in the field of basic combustion. It also should prove valuable in furthering our knowledge of the mechanism of knock and antiknock action.

How Ethyl Research is helping you

By keeping constantly alert to new techniques and advances in scientific knowledge, Ethyl Research people supplement their own technology to expand the ever-widening knowledge of fuels, engines, and combustion.

Ethyl Technical Representatives are available at all times to give your technical people access to the great store of information developed in years of specialized fuel-engine research.

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CURVES FOR RAPID ESTIMATION OF GASOLINE PLANT INVESTMENT

These three curves give a quick plant investment, with 85 percent accuracy

B. T. Brady and R. L. Rorschach
Warren Petroleum Corporation
Tulsa, Oklahoma

"FAST, ACCURATE, AND CHEAP" is the unattainable ideal of all estimating procedures. In practice, however, "fast" and "accurate" are the opposite ends of the estimating spectrum, while "cheap" is what last year's estimate was, compared with this year's.

On the "fast" side of the scale is this procedure for the preliminary evaluation of a proposed project. It consists in picking cost values from individual curves for each major processing section of a gasoline plant, correlating a wide variation in feed gas conditions and processing scheme. Given the plant location; the amount, composition and pressure of the gas; the required hydrocarbon extraction, the plant investment can be estimated in a short time with about 85 percent accuracy. The curves presented here were made up for gasoline plants, but the method can be applied to any type of chemical or petroleum processing operation.

Basis of the Technique

For the purpose of this method it was assumed that a gasoline plant consists of a conventional combination of compressors, absorption and oil processing systems, and various fractionating steps, plus associated auxiliaries and utilities. It was assumed also that the plant under consideration would be a "grass-roots" project, rather than being added to an existing installation. Curves of cost vs capacity were then constructed which would allow the installed cost of each processing section to be estimated, with the sum being the total plant estimate. Each curve was established from detailed estimates of several plants with a wide capacity spread. The various processing sections with their required utilities were separated, and the installation costs were assigned in proportion to the purchased cost of major equipment.

Estimating Compression Section Investment

In the compression section curve, derated horsepower per million standard cubic feet per day was plotted against overall compression ratio, which is defined as the final stage discharge pressure from the aftercooler divided by the first stage suction pressure. Compression ratio per stage was calculated assuming balanced ratios, with pressure drops across the stage coolers of 10, 2 and 0.5 percent of the respective stage discharge pressures. This permits plotting a curve which is independent of the suction pressure values, and which varies only slightly from the curve calculated using constant pressure drops across the coolers.

Horsepower per MM std cu ft per day was calculated from the compression ratio per stage, the gas specific heat ratio "n," the number of stages required, the suction temperatures and the NGAA Compression Charts. It was found that "n" has only a small effect on the calculated horsepower, so an average value was used based on a gas molecular weight of 25. Fig. 1 shows this curve, with rather sharp changes in slope where it was necessary to use two and three stages to maintain a stage compression ratio of five or less.

The nominal horsepower may be calculated from the derated horsepower per MM std cu ft per day, the gas volume to be processed and the applicable altitude derating factor. The purchased horsepower is determined by the desired combination of standard compressors (400, 500, 660, 880, 1100 hp, etc.) to give the nominal horsepower. Installed cost is then $240 per purchased horsepower.

Bonner T. Brady is a senior process engineer with Warren Petroleum Corporation, a position he has held for one year. Prior experience includes eight and one-half years as a process and operating engineer for Pan American Petroleum and two years in plant operations for General Chemical Company. Brady served three years in the South Pacific during World War II. His educational background includes a BS in chemical engineering from the Missouri School of Mines and a MS in chemical engineering from the Georgia School of Technology.

Co-author **Robert L. Rorschach** has been a senior process engineer with Warren Petroleum Corporation for the past two years; eight years' previous experience in research, engineering and production in the chemical and petroleum industries. He obtained his bachelor's degree in chemical engineering from Massachusetts Institute of Technology in 1943, a master of science degree in petroleum refining from University of Tulsa in 1947 and a master's in chemical engineering from Massachusetts Institute of Technology in 1950.

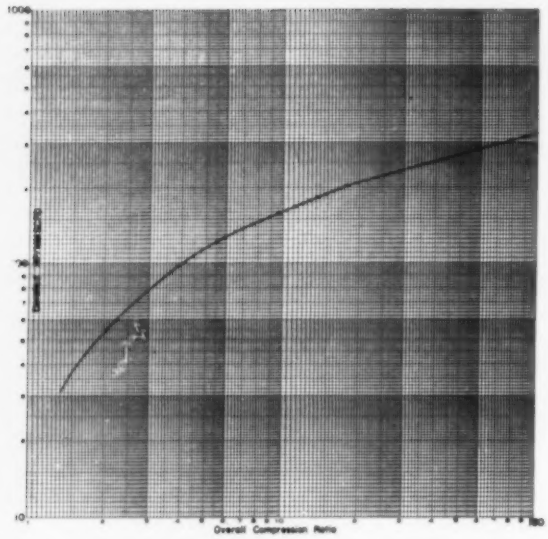


FIG. 1. This curve gives derated compressor horsepower as a function of compression ratio. Use $240 per purchased horsepower as the installed cost.

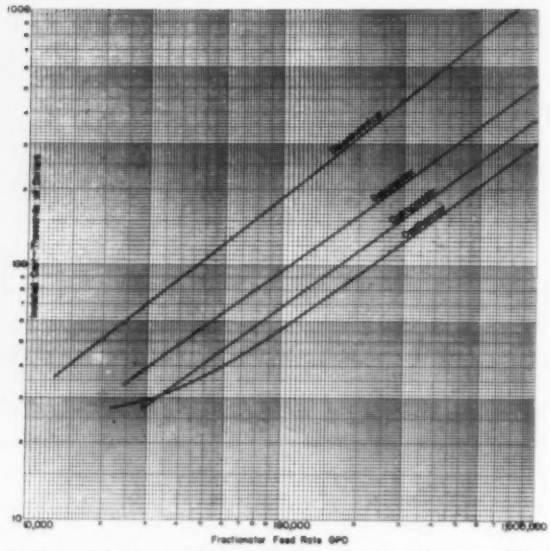


FIG. 3. Installed cost of fractionating equipment is a function of feed rate.

Absorption and Oil Processing Section

The Absorption and Oil Processing Section was assumed to consist of a conventional absorber, a rich oil stabilizer, a thermal stripping still, and an oil presaturator, together with associated vessels, pumps, and heat exchangers. It was also assumed that the raw gasoline from the still could be totally condensed without refrigeration or recompression. Curve for this section, Fig. 2, is plotted as Installed Cost vs Oil Rate to the Absorber. Given the feed rate and composition of gas to the absorber, the absorber operating conditions, and the required propane extraction, any standard method may be used to calculate the absorber lean oil rate required.

Each of the fractionator units was assumed to be a conventional system, with water-cooled reflux for the deethanizer and depropanizer, and air-cooled reflux for the debutanizer and butane splitter. The unit curves in Fig. 3 present Installed Cost vs Column Feed Rate, which can be calculated from the rich gas rate and composition, and the required hydrocarbon extraction. Curves for treater and dehydrator units, or for any other auxiliary systems, can be added, if desired, using the same method.

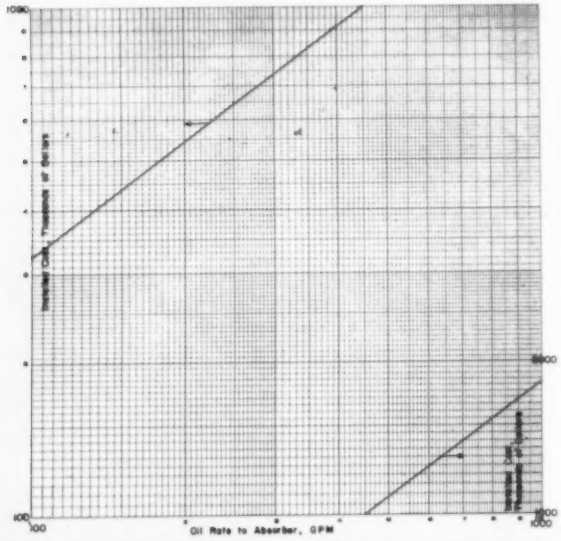


FIG. 2. Cost of the oil processing section is a function of lean oil rate. The costs here include a conventional absorber, rich oil stabilizer, thermal stripping still, oil presaturator, and associated equipment.

Example Problem:

50,000 Mcf per day of gas is to be compressed from 15 psia to 600 psia, at an altitude of 4000 ft, and the liquid products extracted by absorption. After fractionation the products will be propane, normal and iso-butane, and gasoline. The absorber rich oil is to be demethanized in the rich oil stabilizer, with a products deethanizer being used as the first fractionation step. Addition of 700 gal per min of lean oil to the absorber results in feeds of 80,000 gal per day of the deethanizer, 60,000 gal per day to the depropanizer, 30,000 gal per day to the debutanizer, and 20,000 gal per day to the butane splitter.

Overall compression ratio is 40, and Fig. 1 gives a value of 253 hp per MM std cu ft per day corresponding to this ratio. The altitude derating factor for 4000 ft is 0.892, so nominal hp $= 50 \times 253 \times 1/0.892 = 14{,}182$ hp. Thirteen 1100 hp machines will supply this nominal horsepower, giving an installed cost of $240 \times 13 \times 1100$, or $3,432,000.

From Fig. 2 an installed cost of $1,400,000 corresponds to an absorber oil rate of 700 gal per min. From Fig. 3 the installed costs of the fractionators are found to be $48,000, $46,500, $39,500, and $51,000.

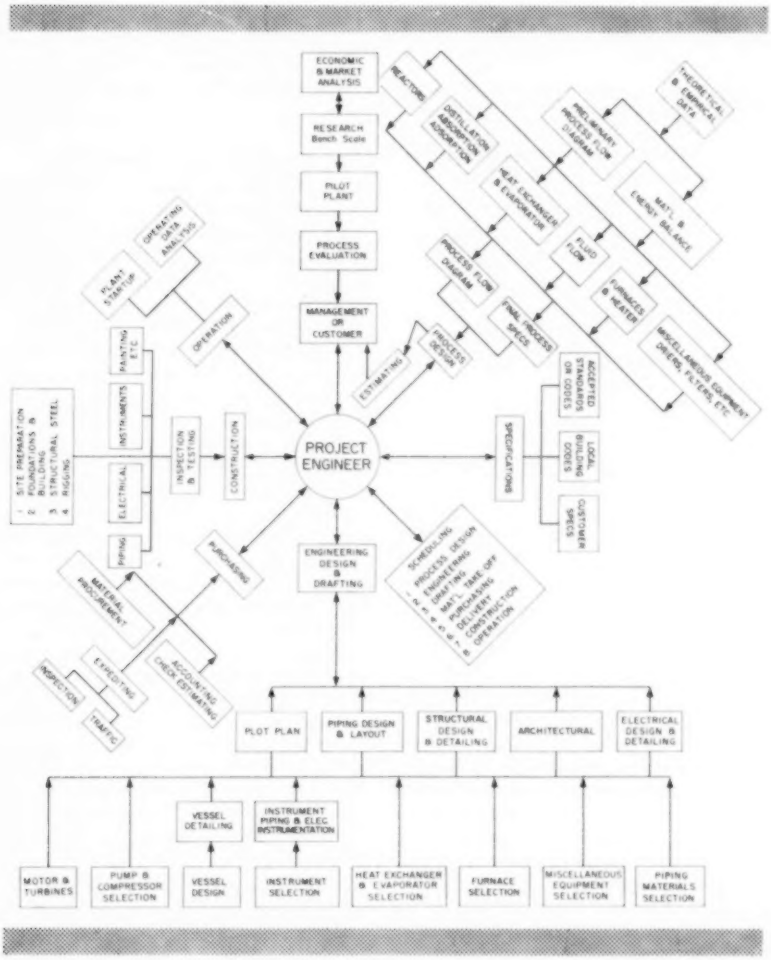
After each individual section has been estimated, the costs are added together to give a total estimate of $5,017,000. If desired, this figure may be adjusted by application of the latest cost index factor.

Limitations of this method are those usually associated with rapid estimating procedures. The simplifying assumptions which permit fast estimation and broad application also introduce errors. For example, the curves are not really smooth, continuous lines, but series of small steps, since each processing section will have a range of capacities over which it can operate. Further errors are caused by departure from conventional "grass-roots" installation. An addition to an existing plant would probably require a different allocation of utilities and installation costs than was used in constructing these curves. For a preliminary estimate, however, within 15 to 20 percent, this procedure meets the requirements and can be used extensively. ★ ★ ★

Role of the Project Engineer in PLANT DESIGN AND CONSTRUCTION

Here's how the project engineer functions as the key man in a complex business and technical organization

Howard F. Rase
University of Texas
Austin, Texas



EFFICIENT ORGANIZATION, one of the outstanding characteristics of American industry, is superbly illustrated in the organization of process plant design and construction under the leadership of a project engineer. He is the master coordinator of the entire project and as such is the hub of an organization composed of business and technical specialists. Upon his shoulders rests the responsibility for both technical and financial success of the project which makes mandatory approval by him of all major decisions. These are challenging duties the full import of which can be understood by examining the stages of a project from preliminary idea to completed plant.

The accompanying diagram shows the progress of a typical project and the corresponding duties of the project engineer.

The Inquiry Stage

An operating company such as a petroleum refiner decides to build a new plant only after careful research and pilot plant work together with process economic studies and market analysis. When this decision is made, general process specifications are compiled for the project. These specifications are transmitted to various engineering and construction firms (contractors) for the purpose of obtaining their quotations.

Upon receiving such an inquiry the contractor assigns a project engineer responsibility for the job. He immediately assumes the position of liaison between the potential customer and all departments of the contractor. He works with the process design and estimating groups in preparing a quotation.

Initial Design Phases

After the quotations have been reviewed by the customer and the contract awarded, the project engineer of

Diagram reprinted by permission from "Project Engineering of Process Plants," by H. F. Rase and M. H. Barrow, John Wiley & Sons, Inc., 1957.

the successful bidder initiates a series of well-timed and simultaneous efforts designed to culminate in a successful plant which is designed and constructed in the agreed time period.

The process design group begins the detailed process design of the plant. At the same time general specifications for all phases of the project are written and a detailed schedule for process design, engineering, purchasing, and construction is prepared.

The schedule immediately demonstrates what portions of the design, procurement of materials and construction are the most time consuming. These phases then receive the earliest attention. As an example, preliminary orders for vessels can be made on the basis of process sketches so that the vessel manufacturer can immediately place an order for steel plate from the mill. The project scheduling, however, does not end here; the schedule must be revised regularly, so that it will be a useful tool for following work progress and insuring completion of the work on time.

Engineering Design and Drafting

The project engineer receives the final process design and after careful study transmits the necessary information to various specialty groups for development of final equipment specifications, designs, and layout as well as design of piping and structures. This information is sent in writing together with general specifications and an engineering flow diagram.

The project engineer works closely with these specialists aiding them in interpretation of specifications and customer requirements. He studies and approves their major decisions with great care. In this work he is aided by junior project engineers and his office staff, but the ultimate responsibility is his.

The goal of this engineering design phase is the production of drawings and detailed specifications which represent the official guide for the procurement of equipment and material and for construction of the plant.

Procurement

As fast as data are developed by the engineering design group they are sent to the project engineer for approval and rapid transmission to the purchasing (procurement) department. It is here where another key operation in plant design and construction begins. A design project, though pursued with great technical competence can fail if the procurement is improperly scheduled and unwisely directed.

Equipment and materials to be purchased for a project may be divided into three groups:

1. Equipment designed by the contractor (e.g., vessels);
2. Equipment specified by the contractor but selected from standard models (e.g. pumps);
3. Equipment and materials of standard design purchased on the basis of price and minimum specifications (e.g., pipe).

The project engineer approves all procurement decisions but becomes involved only infrequently in those based on Group 3. Purchases, however, involving technical judgment (Groups 1 and 2) require the close attention of the project engineer who will, if necessary, consult with the specialists in the process design and engineering groups.

Although the purchasing department may be staffed with men having a technical background, it is impossible for these men to be up-to-date in both business trends and technical developments. It is natural, therefore, that in both the pre-inquiry and inquiry stages the project engineer makes certain that he and the engineering specialists maintain close contact with the procurement of equipment such as vessels, pumps and instruments.

This contract usually begins in the development of the original specifications for the equipment. The engineer must talk with manufacturer's technical representatives in order to learn of the latest developments. In all such cases, however, these contacts should be made through the purchasing department so the continuity of the procurement program will be preserved and all vendors representatives will be assured of equal treatment.

Regardless of the degree of technical participation in the purchasing operation, the project engineer should rely on purchasing agents' knowledge of commercial practice. A successful relationship between the purchasing department and the engineering department depends largely on the project engineer's ability to develop the confidence and understanding of both.

Since a prime factor in the scheduling of a project is delivery time for equipment, it is essential that all procurement be coordinated so as to insure delivery of the specified equipment at the proper time. To aid in this goal most purchasing departments have expediting and inspection divisions. Expediters and inspectors follow the progress of all major purchases. By means of visits to the manufacturing plants they are able to aid both the manufacturer and the contractor in fulfilling their mutual desires to deliver properly built equipment at the agreed time.

Construction and Operation

As the design project proceeds the scheduled time for job site preparation arrives. The construction forces headed by the superintendent begin the task of preparing the site. As this work is completed and the construction begins, materials and equipment designed or specified by the engineering groups, purchased by the purchasing department and approved by the project engineer arrive at an ever increasing rate. It is then that the results of careful planning and sound technical and business judgment become spires of steel and complexes of machinery, piping, and electronic controls all integrated into a successful automatically controlled plant. The project engineer who has followed the entire project must continue close contact during the construction and initial start up of the plant, for he is best suited to aid in construction decisions related to design. It is only when the plant has proved that it can produce the guaranteed product at the desired rate that he can relax his guardianship. This relaxation is not long, for soon he is assigned a new job with new procurement and engineering problems. It is this unending chain of new situations which makes this profession one of the most rigorous yet most fascinating and satisfying in all engineering. ★ ★ ★

About the Author

Howard F. Rase *is an associate professor of chemical engineering at The University of Texas. He received his BS degree in chemical engineering from The University of Texas in 1942 and his MS and PhD in 1950 and 1952 from the University of Wisconsin.*

From 1942 to 1944 he was a chemical engineer for the Dow Chemical Company in Shreveport, Texas, and then served as a process engineer with Eastern States Petroleum Company in Houston. Between 1944 and 1949 he served as both a process and project engineer for the Foster-Wheeler Corporation. Since 1952 he has been at The University of Texas. He is co-author with M. H. Barrow of "Project Engineering and Process Plants" published by John Wiley and Sons in April 1957.

SCHEDULING ENGINEERING DESIGN

- A Vital Force in Refinery Operations

H. T. Campbell
Humble Oil & Refining Company, Baytown, Texas

FIRM DATES for the release of designs must be established and adhered to if planned maintenance and construction are to function properly. For example, tardiness of design-work completion on a catalyst-cracking-unit downtime could result in a delay of downtime and the consequent rearrangement of the refinery operating plan.

Engineering design finds itself in the position of holding the key to answers for management questions such as: "When can the facilities for producing product "X" be completed?; When can this new unit be in operation?" Many times the question is phrased another way; "We must have engineering on the job completed by ———. Can you do it? If not, what will have to be delayed to do so?" To answer these questions it is imperative that engineering-design completion dates be predicted accurately.

It is conceivable that potential customers can be lost if design completion dates are not realistic. An accurate and reliable timetable for engineering design is vital to the whole refinery operation.

Analysis of Problem

Establishment of a schedule for engineering-design work in a large modern refinery is a problem which is likely to be more complex than any other problem confronting a design department. Some of the factors contributing to this complexity are:

1. A large number of projects must be worked on concurrently. At times there may be as many as 200 separate projects to be scheduled. In some cases these may be subdivided so that as many as 10 or 15 separate completion dates are required for various parts of a single project.

2. There is great variation in the scope and nature of the projects. Sizes of jobs can range from the installation of a single pump or instrument to construction of a multi-million dollar process plant. Many projects consist of additions and alterations to existing process units and must be coordinated closely with plant operations. Trouble shooting, pre-estimate engineering and miscellaneous services add to the overall problem. And finally the relative amounts of mechanical, civil, electrical and instrument engineering vary greatly with individual projects.

3. The relative urgency of projects is changing continually. In refining, as in any other business "the customer comes first" and the refinery's many customers have changing needs in terms of new products, new specifications and in quantities desired. These needs of the customer can transform a project of low priority quickly into one of vital urgency. Another factor influencing schedules is the minor change in process-unit operations which often produces unanticipated corrosion, erosion, vibration damage or other forms of mechanical deterioration which must be given immediate engineering attention.

4. Refining process technology is advancing rapidly and in many cases newly discovered or newly conceived ideas must be incorporated after mechanical design has been planned and initiated. Although cut-off dates may be established for submission of process design a progressive management will not turn its back on a lucrative idea even though the idea may be submitted late and upset timetables. The potential profits of such ideas demand that schedules be rearranged to include them. Such changes usually increase the overall scope of design work.

5. Refinery-design manpower is usually maintained at a fairly constant level and must be supplemented with outside engineering help as the work load increases.

Formulation Schedule Objectives

Before setting up a system for scheduling refinery-design engineering effectively the desired features of such a plan should be established clearly. One of the primary aims of the plan should be to set definite goals in terms of completion dates and establish the corresponding man-day requirements. This information should be communicated systematically to and be accepted by all members of the team — draftsmen, design engineers, project engineers, maintenance and construction people and management — if the goals are to be attained. Responsibility for attainment of these goals must be established clearly. It is also essential that the people who will actually be performing the work be consulted when dates are being set as there is an almost universal objection to deadlines which appear to be arbitrary.

The making of assignments to individuals must be intermeshed closely with preparation of the schedule. Ideally, assignments should be made to the people best qualified for the job at hand. At the same time each man should be employed to his optimum capacity. The effective schedule must be cognizant of personalities not just numbers of people. The logical method for accomplishing this is for the first-line supervisor to make the assignments and prepare the schedule at the same time.

It is apparent from the previous dis-

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cussion that any system of scheduling in the modern refinery also should be flexible, and should be kept up to date without usurping productive design time. A system with too much inherent complication can cause a design department to "schedule itself into a corner." Simplicity is mandatory.

Finally, any plan of scheduling should have integrity. Overall work loads of individuals and of different groups should be shown in such a manner that comparisons can be made readily. A properly conceived plan can be of great assistance to upper levels of supervision in seeing that there is equal sharing of work load between different groups as well as between individuals. The schedule should serve as an auditing device to insure that one particular design group is not "burned out" while another builds a "little empire."

Formulation of a Schedule

One of the first steps in formulating a schedule is to establish job priorities. This is a function of management and is largely governed by the policies of the company. One logical manner of arranging jobs in order of their relative urgency is:

1. **Safety items.** Items which constitute potential hazards to life and property.

2. **Customer satisfaction items.** Facilities to produce new products or to meet new product specifications which must be completed in the immediate future.

3. **Process-unit downtimes.**

4. **Employee relation items.** Projects to maintain good will of employees.

5. **Research projects.**

6. **Pre-estimate engineering.** Design work which is necessary in order to define scope and cost of projects for management evaluation.

7. **Other approved appropriations.**

In determining the relative urgency of approved projects which do not fit specifically into categories 1 through 6, the annual return, the size of the job, and the elapsed time since approval should be taken into account.

After priorities have been determined the estimation of design man-day requirements is in order. This best can be accomplished by joint action of the first-line supervisor and the engineer who will be performing the design work. To determine this figure each job should be evaluated and a rough analysis of the required design steps should be made. The number of drawings to be prepared, complexity of design, estimated project cost, firmness of process design and availability of supporting information such as manufacturers' drawings must be considered. Priority, man-day figures on past experience and even the individuals who will be involved also should be taken into account. It is emphasized that accurate man-day records should be maintained for guidance in making future estimates and as a check on jobs which are in progress. Correlations between engineering man-day requirements and total job costs can be helpful as general guides but they should not be relied on to the exclusion of the several considerations listed.

4 5 6 7 8	11 12 13 14 15	18 19 20 21 22	25 26 27 28 29	1 2 3 4 5	8 9 10 11 12	15 16 17 18 19	22
							HOLIDAY
BNK	21-7-9348	16-8-7221	21-7-9348	21-7-9348	21-7-9348	NS	
LFW	NS	NAA 330	21-7-5391	VACATION		21-7-5391	

FIG. 1. **Engineering Design** Schedule Sheet. NS indicates not scheduled or allowance for unanticipated jobs. NAA indicates non-appropriation assignment.

The third step in establishing a schedule is to apply the priorities and man-day requirements of the projects at hand to the available design manpower. At first examination this would seem to be a matter of simple arithmetic, but unfortunately this is not the case. The effective schedule must, at this stage, take into account the nature and complexity of the job, the work load and capabilities of available designers and the other objectives previously discussed.

Two Scheduling Tools

Our company has developed two complementary tools to meet these requirements. One of these is a semigraphical form which plots each man's work assignments against the calendar. Fig. 1 shows the general arrangement of this form. Each horizontal line is assigned to one individual and work assignments are plotted directly on the form. Holidays, week ends, and a reasonable allowance for unanticipated jobs are excluded from each man's available time. To make the form more accurate all other nonproductive time such as vacations and substitutions in other departments is also plotted as soon as this information is known.

The first-line supervisor is responsible for maintaining this schedule sheet on a current basis for his group. At two-week intervals a revised copy of the schedule is published and distributed to all interested groups. The form is thus an accurate and up-to-date representation of individual and group work loads. It is an important aid to the immediate supervisor in making assignments and in establishing completion dates.

The second tool is a printed form which summarizes the status of design and drafting on all active projects. Table 1 shows the general arrangement for this form. This sheet reflects, for each project, the design completion date, highlights of status, total man-days expended, original estimated man-days and a man-day analysis in terms of the various design groups involved. It also serves as a directory to indicate which designers are assigned to the job from different groups. In the event that the completion date must be changed or if there is some delaying element that information is also re-

TABLE 1. Design Status Sheet Showing Typical Information for One Project. (Design and drafting to be done as of March 19)

Appr'n No.	Title and Status:	Man-Days Spent Remaining	Engineer
21-7-9348	Additional Reheat Circuit, Hydroformer	680/640	WSD
A-D Rel.		BNK 15 M 5	BNK
E—4/8	1. Work on pkg. E. (Overhead piping &	BEW 3 E 1	53
4/15*	Platforms) in progress.	JRD 4 I 2	
Fx—6/1	2. All materials requisitioned.	TJH 15 C 5	
	*11. Pkg. E delayed to work on Appr'n. 16-8-7221	CEH 30 D 5	

Footnote: Letters apeparing under Appr'n. No. refer to complete portions or packages of the project; for example package "E" covers overhead piping and platforms. Package A through D have been released to field. The man-day fraction 680/640 indicates that 640 MD was the original estimate and as of March 19 it appeared that 680 MD total would be required to design the project. The item BNK 15 M 5 indicates the initials of the mechanical engineer assigned to the project and that 15 man-days of productive work and 5 days of follow-up remain to be performed. Similarly initials E, I, C and D refer to electrical, instrument, civil and drafting. WSD is the project engineer and BNK is the lead designer. The number 53 is the priority.

flected on the status sheet. Maintenance on a current basis is the joint responsibility of the lead designer and the first-line supervisor. This form is brought up to date at two-week intervals to coincide with the schedule-form revisions and copies are regularly distributed to all interested parties. The schedule form serves as a check on the status sheet since man-day requirements and completion dates must be compatible with time actually available as indicated on the schedule form.

This system has been in the process of evolution for several years. It is believed that it meets most of the requirements of a sound scheduling plan. With the exception of the preparation of man-day estimates almost all the work of maintaining the schedules is performed by supervisory and clerical personnel and therefore a minimum of productive design time is spent in scheduling. Although there is still room for improvement, accuracy in prediction of completion dates is showing a continuing upward trend. It is our belief that as more experience is gained it will be possible to predict completion dates accurately for practically all of the many projects to be engineered.

Many Factors Involved

The establishment and maintenance of an effective engineering design schedule in a large refinery is a task that merits the cooperation and understanding of all concerned. There are many factors working against adherence to predicted completion dates. Despite the most sincere efforts there will be many cases where man-day requirements will exceed the original estimates. There is constant pressure from project engineers, operating people and from management to improve dates or to establish dates that past experience might indicate to be unreasonable. The unanticipated jobs and unexpected additions to projects will continue to contribute to the dynamics of the over-all problem. As long as the schedule is used as a guide to determine the timing for and extent of contracting of engineering to outside consultants then schedules must be made as realistic and accurate as possible. Gross over-estimation of man-day requirements or over allowance for the unexpected can easily result in over-contracting and consequent inefficient utilization of company personnel. Scheduling of design work is indeed an important and a challenging problem for refinery engineers.

Acknowledgment

The author wishes to express his appreciation to members of the Humble Oil & Refining Company Engineering Division for their assistance with the preparation of this paper. ★ ★ ★

NGAA Sets Technical Program For 37th Annual Meeting

Here's the technical and business program for the National Gasoline Association of America's 37th Annual Meeting, to be held in the Baker and Adolphus hotels in Dallas, Texas, April 16 through 18.

Wednesday, April 16

8:00 a.m.: Technical and LPG Committees Joint Meeting
9:30 a.m.: Corrosion Committee Meeting
10:00 a.m.: "K" Committee Meeting
10:00 a.m.: Board of Directors Meeting and Luncheon.

2:00 p.m.: **Forum: Chromatography**

Chromatography on the Pacific Coast — a report of California Natural Gasoline Association activities.

Chromatography as a Guide to Fractionator Operation — by A. B. Altom, Warren Petroleum Corporation.

Use of Chromatography as a Laboratory Control Instrument for Plant Operation by L. N. Locke, Continental Oil.

Routine Use of Chromatography on Light End Stocks — by J. F. Hickerson, Humble Oil & Refining Company.

Gas Analysis by Chromatography and Interpretation of Chromatographs — by M. F. Deavours, Superior Oil.

(*Title to be announced*) — by Ralph Styring, Atlantic Refining Company.

Laboratory Analysis of Natural Gas by Chromatography— by Dan Smith, Phillips Petroleum Company.

Automatic Chromatographs for Process Monitoring & Control — by Mel Fourroux, Phillips Petroleum Company.

2 p.m.: **Forum: Internal Communications and Organization**

Training and Development — by R. L. Switzer, Atlantic Refining Company.

Management-Labor Relations — by H. R. Sheperd, Cities Service Oil Company.

The Interdependence of Organization and Communications — by J. N. Beasley, Humble Oil & Refining Company.

Delegation of Authority — by Ed McCleskey, Tennessee Gas Transmission Company.

2 p.m.: **Forum: Motor Fuels and Engines**

Engines and Fuels — by T. W. Legatski, Phillips Petroleum.

Potential Application of Manganese Anti-Knock Compounds in Natural Gasoline — by W. W. Sabin and R. J. Riggs, The Ethyl Corporation.

Thursday, April 17

9:30 a.m.: **Forum: Cutting Plant Costs**

Design — by N. C. Turner, Hudson Engineering Company.

Modifications — by V. E. Middlebrook, Consultant.

Operations — by R. F. Naul, The Texas Company.

The Human Side of Job Planning — by E. Y. Palmer, Atlantic Refining Company.

9:30 a.m.: **Forum: New Design Trends**

Use of Business Machines in Design: Fitting "K" and Enthalpy Charts to Computers — by Dr. Brymer Williams, University of Michigan.

Practical Applications of Computers in Engineering Design of Gasoline Plants—by R. L. McIntire, The Datics Corp.

Treating High CO_2 Content Gas — by R. B. McLaughlin, Northern Natural Gas Company.

Hot Potassium Carbonate Removal of CO_2 — by B. O. Buck, Petrocon Engineering Company.

2:00 p.m.: **General Session**

Chairman: Warren Kraft, Honolulu Oil Company.

President's Address: George T. Tennison, Shell Oil Co.

Presentation of the Hanlon Award.

Conservation of Natural Gasoline in Texas — Gen. E. O. Thompson, Texas Railroad Commission.

Address — Ernest G. Swigert, president of the Hyster Corporation, Portland, Oregon, chairman of the board, National Association of Manufacturers.

Friday, April 18

9:30 a.m.: **General Session**

Chairman: E. W. Kilgren, Pan American Petroleum Corp.

Presentation of Safety Awards.

Technical Committee Report—Charles E. Webber, Sun Oil.

Forum: Where Do We Go From Here?

Implication of Continued FPC Regulations—by J. F. Jones, Pan American Petroleum Corporation.

Future Use of Natural Gas Liquids in Petrochemicals—by Anson P. Hobbs, Dow Chemical Company.

Processing of Light Ends into Petroleum Fuels — by Universal Oil Products Company.

ROLE OF THE PROCESS ENGINEER IN

DEVELOPING EQUIPMENT SPECIFICATIONS

Dr. Charles H. Brooks *is a process engineer in the engineering division of the manufacturing department of the Sun Oil Company. He spent two years in the research and development department of the Socony-Vacuum Oil Company.*

After completing graduate school at the University of Michigan, where he was a teaching fellow, Dr. Brooks joined the Sun Oil Company in their research and development department as an associate development engineer in 1936. In 1940 he transferred to his present position.

He was on active duty with the U. S. Navy from 1941 to 1946 in the Bureau of Ordnance in connection with powder, explosives and ammunition chemicals. He has been granted a BS degree from Yale University and MS and ScD degrees from the University of Michigan. He has four papers and six patents to his credit.

THE PURCHASING of special purpose equipment for today's oil industry has become a highly technical matter. It demands the services of more and more professionals, particularly in regard to the setting of specifications. One of these professionals is the process design engineer.

His role in buying is to determine how well equipment specifications agree with performance requirements. The solution of that equation gives the answer to how well the processing equipment will work on the job. Installation costs of course must be considered also, but it is specifications that assure the purchaser the equipment will perform properly in use.

The process design engineer is particularly fitted for his role here. He has first-hand knowledge of such factors as the operating conditions to which the material is to be exposed, its pressure and temperature, or other factors that affect process performance vitally.

As a process engineer, his initial training probably is in chemical engineering. But many process engineers have been trained in some other branch of engineering, and in addition have acquired a working knowledge of process matters.

Pieces of the Puzzle

Performance and mechanical specifications comprise the two parts of equipment specifications. The former include rates or quantities, operating temperature and pressure, and other factors relating directly to process performance. These are, for example, size of pressure vessels or towers, tray layout for distillation towers, and service conditions for many pieces of equipment. Equipment efficiency is determined largely by the degree to which these requirements are satisfied.

Mechanical details, too, may affect performance. They may involve the location of the draw connections on a side stream distillation tower, for instance. So certain mechanical specifications should be considered as part of the process performance segment of equipment specifications.

Mechanical performance of the equipment includes such things as ease of maintenance, ability to withstand corrosion, and time between maintenance shut-downs. All of these things can be lumped together into the term "reliability."

In mechanical specifications are such things as detailed mechanical design, including shell thickness, supports for equipment, fabrication details like welding procedures and innumerable other items. There are also line and nozzle sizes, construction materials dictated by service conditions specified for the performance, and the "rubber" to provide a safety factor — all items of importance in equipment selection but generally not affecting process performance. These are in the province of the project engineer.

We see, therefore, that the process engineer is the one who, in developing equipment specifications, determines at what capacity, how hot, and at what pressure a particular process will function. The project engineer utilizes data developed by the process engineer to create an actual plant, composed of units that will do the job called for by the process engineer's calculations.

Teamwork with the Project Engineer

Chemical engineers often will be found in the ranks of project engineers. Their function there is more from the mechanical than from the process side. The project engineer's work entails a lot more than the selection of pieces of operating equipment. He is involved also in foundations, pipelines and instrumentation, all of which must be developed before an actual operating plant can be designed and built.

The project engineer and the process engineer, working as a team, develop the final specifications. There are, however, certain areas of the specifications where neither engineer can be said to have primary responsibility. This is the cooperative area where the two engineers must reach agreement without infringing on areas that are not their special responsibility.

Reviewing Deviations

An aspect of specifications that must also be considered is the evaluation of minor deviations. Equipment vendors sometimes submit proposals which deviate from specifications, particularly the mechanical portion worked out by the process and project engineers. In some cases these deviations are in the basic proposal, but in other cases are submitted as alternates, which generally show a lower initial cost. Under these circumstances, the process and project engineers concerned must evaluate the effect of these on the overall performance, both mechanical and process. Here again there is necessity for the widest possible cooperative effort between these two types of engineers.

Generally speaking, performance specifications differ with each job and so should be handled primarily by the process engineer. At the same time, those mechanical details not affecting process performance can be based on standard mechanical specifications. But it should be pointed out that when anything is standardized, there should be a periodic review of the standards. And this review should be the job of the kind of engineer who was responsible for developing the specifications in the first place. Thus, the review of mechanical specifications would be handled by the project engineer. ★ ★

Use Digital Computers as DISTILLATION COLUMN DESIGN AID

Here's how short-cut and rigorous methods can be combined to cut machine time for designing a butane splitter

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IN DESIGNING a distillation column, the first step to be taken is to find the range of operating and design variables within which a satisfactory product can be made. There are two ways in which this can be done. One way is for the engineer to "guess" the tower design. If the first assumptions made are not satisfactory, adjustments are made until tower operation will meet design specifications.

A second way is to use conventional design procedures programmed for computer solution. Machine calculations are speedy and make possible the investigation of several alternatives in tower operation.

Both short-cut and plate-to-plate distillation calculations have been programmed for computer solution. Each has its place for application and, when used properly, can provide a rapid and economical tower design.

Short-cut Design

These methods are those based on tower design limits, i.e., minimum reflux ratio and minimum number of theoretical plates. The short-cut procedure used here is a combination of the minimum number of stages calculated by the method of Fenske,[2] the minimum reflux ratio from the method of Gilliland,[3] as modified by Maxwell,[6] and the estimated actual number of stages and actual reflux ratio as determined from a correlation presented by Gilliland.[4]

The equation derived by Fenske is shown in Equation 1.

$$\alpha_{LK}^{S_m} = \left[\frac{X_D}{X_W}\right]_{LK} \left[\frac{X_W}{X_D}\right]_{HK} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This equation relates overhead and bottom product compositions in a distillation column operating at total reflux. Ordinarily, it is used to determine the minimum number of theoretical plates necessary to effect a given separation between two components. However, it can be used to determine the separation for one component when the number of plates and separation of the other component is specified. After the minimum number of plates has been calculated, and the separation for the key components defined. Fenske's equation can be used to compute the distribution of all components between the overhead and bottom streams.

Compositions calculated by the Fenske equation are exact only at total reflux. Except for the key components, there will be some variation in separation with reflux ratio. Variation will not be great, however, and the compositions are suitable for use in the short-cut calculations.

Maxwell's modification of Gilliland's minimum reflux equation is shown in Equation 2.

$$R_{m+1} = \left[\frac{\alpha_{LK} I_{LK} + 1}{\alpha_{LK} - 1}\right] \left[\frac{X_{LKD}}{I_{LK}} - X_{HK_D}\right] + \Sigma_L \frac{\alpha_L}{\alpha_L - 1} \left[X_{L_D} - I_L X_{HK_D}\right] + \Sigma_H \frac{\alpha_H}{\alpha_{LK} - \alpha_H} \left[\frac{X_{LKD}}{I_H} - X_{HD}\right] \quad . \quad (2)$$

The first term on the right corresponds to the minimum reflux equation for a binary mixture of the key components. The second and third terms are, respectively, corrections for light and heavy components with finite volatility. After the product stream compositions have been determined, this equation can be used to estimate the minimum reflux ratio for the separation.

After the minimum number of plates and minimum reflux ratio have been determined, Gilliland's correlation of actual and minimum reflux ratio with actual and minimum plates can be used to estimate the actual reflux ratio—actual number of theoretical plates relationship.

Plate-to-Plate Method

The plate-to-plate calculation procedure used is that presented by Lewis and Matheson.[5] Bonner[1] adapted the Lewis and Matheson method for computer solution. A sequence of material and energy balances is run on successive plates in the rectifying and stripping sections of the column. Calculations are begun at condenser and reboiler and continue from each to the feed plate. At the feed plate, stream compositions based on calculations from the top and the bottom of the column are compared. Errors are adjusted to terminal stream amounts and applied to the product streams. Top-down and bottom-up calculations based on these adjusted compositions are then initiated. This procedure is repeated until all feed plate compositions agree within a specified limit of error.

Application to Design of Butane Splitter

How can each of these programs be utilized to best advantage in the solution of a distillation design problem? This question can perhaps best be answered by presenting the solution of a specific problem.

For an example, let us consider the design of a butane splitter column operating under the conditions specified in Table 1.

Short cut method determines range of variables. The first step is to determine what range of variables will provide satis-

TABLE 1. Design Specifications.
Feed Composition Mole Fraction.

Composition	Mole Fraction
C_3	.004
iC_4	.115
nC_4	.331
iC_5	.163
nC_5	.180
$C_{6's}$	.185
$C_{7's}$	.022

Overhead Condensing Temperature — 100 F
Tower Pressure — 100 psia
Overhead Product Specification — 95% iC_4

factory operation for the tower. The short cut type calculation is ideal for this work.

Looking again at Fenske's equation (Equation 1) we see three possible variables: Light key split; heavy key split; minimum number of theoretical trays. When any two of these are specified, the third can be calculated. By choosing values properly for two of these variables, data points for all three can be calculated for a wide range of possible tower operating conditions.

One thing immediately obvious is that overhead recovery of isobutane must be high or the overhead product will not meet the 95 percent purity specification. The relatively large fraction of propane in the feed stream necessitates high iC_4 recovery overhead. This eliminates a wide range of tower operating conditions that otherwise might have to be included.

For this problem, the minimum number of trays and the light key split are specified. Range of each of these variables is shown in Table 2.

Using one value of light key split and one value of minimum number of plates, the computer calculated:

1. Overhead composition.
2. Bottom composition.

TABLE 2. Range of Variables.

LK Split	% of iC_4 Overhead	S_m
4	80	10
6	85.7	15
10	90.9	20
15	93.8	25
25	96.1	30
50	98.0	35
		40

3. Moles of product overhead.
4. Moles of product out bottom.
5. Overhead dewpoint temperature.
6. Bottom bubblepoint temperature.
7. Minimum reflux ratio.
8. Points on actual plates — actual reflux ratio curve.

Design variables. Of concern are overhead purity, number of theoretical plates required, reflux ratio, recovery of isobutane in overhead product. Fig. 1 shows the variation of overhead composition with minimum number of theoretical plates for the different values of light key split. From these curves one can determine the minimum number of theoretical plates required to produce 95 percent isobutane for each value of iC_4 overhead recovery.

Fig. 2 shows the relationship between moles recovery of overhead product and minimum number of theoretical plates for different overhead recoveries of isobutane. Each of these curves approaches asymptotically a minimum value which is the sum of the propane in the feed and the specified overhead recovery of isobutane.

A cross plot of the data of Fig. 1 and 2 is shown in Fig. 3, where the overhead recovery of 95 percent iC_4 is plotted as a function of the minimum number of theoretical plates required to obtain 95 percent iC_4. From Fig. 3 one can see that at low overhead recoveries of iC_4, more iC_4 can be re-

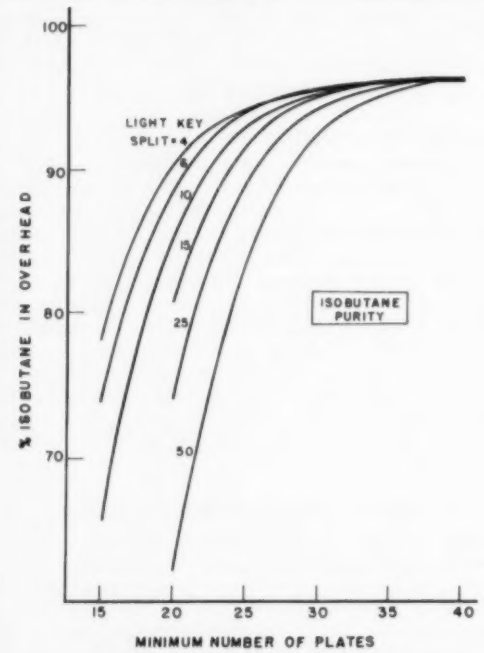

FIG. 1. Relationship between number of column plates and purity of isobutane overhead.

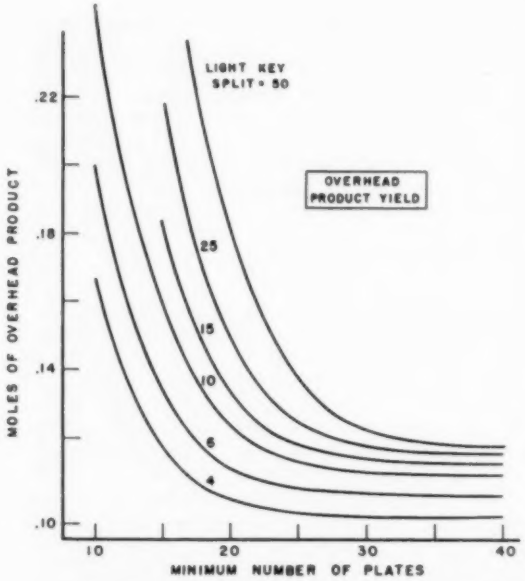

FIG. 2. Relationship between number of column plates and overhead product yield.

covered without a large increase in the number of plates. At higher recoveries, the number of plates increases much more rapidly.

Effect of minimum number of plates on minimum reflux ratio is shown in Fig. 4. As expected, each curve approaches asymptotically a maximum value at high values of S_m.

Close approach of all the minimum reflux values to the same value might not be expected. This is a reflection of the increased amount of heavy key component carried overhead by higher and higher recoveries of light key component overhead.

The effect of light key split on the reflux ratio required to make 95 percent isobutane is shown in Table 3.

TABLE 3. Minimum Reflux Required to Produce 95 Percent iC_4

Light Key Split	Rm at 95% iC_4
4	12.34
6	12.33
10	12.34
15	12.32
25	12.30
50	12.34

As expected, the minimum reflux values for all different values of light key split are essentially the same. Since the basic criterion in Table 3 is production of 95 percent isobutane in the overhead product, the variation in minimum reflux ratio is caused by small errors, such as rounding errors in the computer calculations and human errors in determination of the smooth curves through the calculated data points.

Basis for plate-to-plate calculations. The principal variable of concern to the design engineer in this example is illustrated in the Fig. 3 where the minimum number of plates to produce 95 percent isobutane overhead product is shown. From this curve, a good value for the minimum number of plates and light key split required to produce a specification overhead product is 30 minimum plates and a light key split somewhere between 15 and 25. This data was taken as a basis for the plate-to-plate calculations.

Plate-to-Plate Calculations

Necessary input data is the number of actual theoretical plates and the actual reflux ratio necessary to make a specified split. The actual plates —actual reflux ratio relationship can be developed from the calculated data of the short cut data deck. One of the outputs of the short cut calculation is the actual plates — actual reflux ratio curve as developed from the correlation of Gilliland. A typical curve for this relationship is shown in Fig. 5. This curve is for 25 minimum theoretical plates and a light key split of 4.

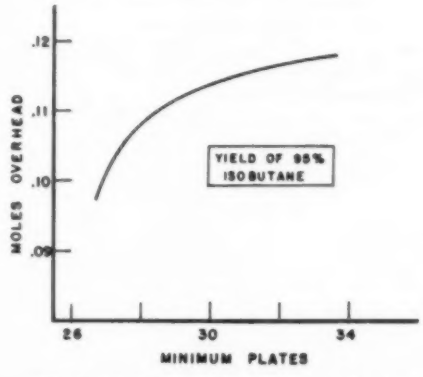

FIG. 3. Relationship between number of column plates and yield of 95 percent isobutane.

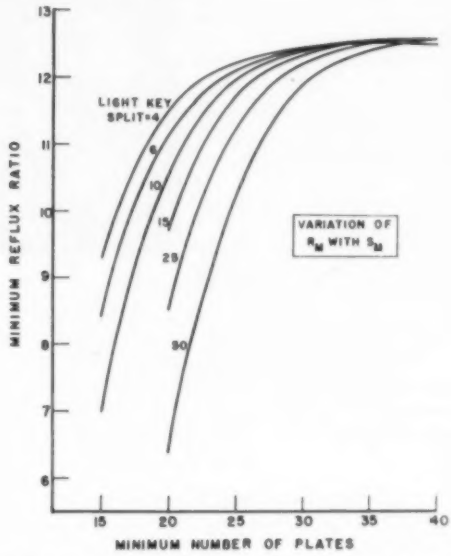

FIG. 4. Effect of minimum number of plates on minimum reflux ratio.

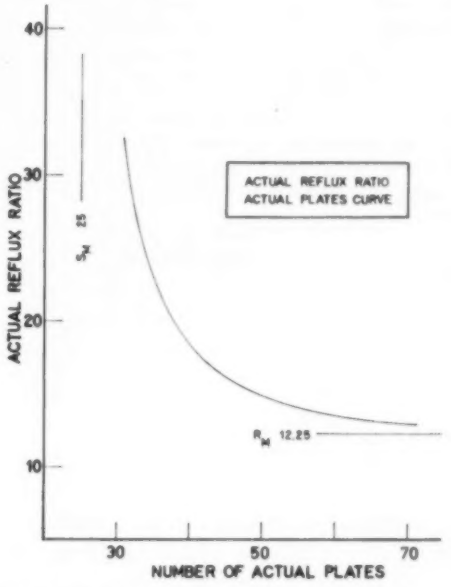

FIG. 5. Actual plates-actual reflux ratio curve as developed by Gilliland's correlation.

Fig. 5 shows that the actual reflux ratio asymptotically approaches the minimum value for this separation at high values of minimum theoretical plates. On the other extreme, the reflux ratio approaches infinity as the number of plates approaches the minimum value of 25. From these curves, a reflux ratio of roughly 17.2 would be required with 50 actual plates to produce a 95 percent isobutane overhead product at a light key split of 15. At a light key split of 25, with 50 actual plates, a reflux ratio of 17.0 would be required to produce 95 percent iC_4. However, in this latter case, the overhead purity of the isobutane product is not

The Author

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He has been a member of the faculty at Oklahoma State (formerly Oklahoma A&M) since June 1950, except for one year spent in the process division of BS&B at Oklahoma City.

Dr. Maddox received his PhD from Oklahoma State in 1955, a master's in chemical engineering from University of Oklahoma in 1950, and his bachelor of science in chemical engineering from University of Arkansas in 1948. He is currently chairman of the Central Oklahoma Section of the AIChE.

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quite within the 95 percent limit specified in the initial design data.

Results

Actual number of theoretical plates chosen for plate-to-plate solution was 50. The moles of overhead product chosen were .115, which is roughly half way between the overhead production expected at a light key split of 15 and what would be expected at a light key split of 25. From this, using a reflux ratio of 17.2, overhead purity specifications were not met. An increase of the actual reflux ratio to approximately 23 yielded a satisfactory overhead product. Table 4 shows some of the results of the plate-to-plate calculations.

TABLE 4.

Component	Mole Fraction Overhead	Mole Fraction Bottoms
C_3	.03756	
iC_4	.95270	.01515
nC_4	.00974	.36929
iC_5		.18243
nC_5		.20145
C_{6+}		.23167

Actual Theoretical Plates 50.
Actual Reflux Ratio — 23::1.
Yield of Overhead Product .1064 moles/mole feed.

The isobutane concentration in the overhead is slightly greater than 95 percent. This means that this product will meet design specifications.

The reflux ratio required in the plate-to-plate calculation was approximately 30 percent greater than that predicted by the actual plates — actual reflux ratio relation. This error is not excessive and is within the accuracy limits that might be expected from a general correlation of this type.

In addition to the information shown in Table 4, the plate-to-plate calculation generates a final vapor rate and temperature profile for the column. This gives the composition and temperature of vapor and liquid on any plate in the distillation column. From this information, it is a simple matter to determine the characteristics and physical properties of the vapor and liquid at any point in the column. This is all the data that is needed for completion of tower diameter and plate design calculations. It would be perfectly feasible to program these latter calculations for solution on the computer. Input data would simply consist of the vapor and liquid loading at the particular point in the column under scrutiny. That this has not been done, is a matter of convenience rather than of difficulty in programming.

Relative Computing Times

A point of interest here might be the relative computing times involved in the solution of this example problem. The data generated by the short cut deck required approximately one hour of computing time. In this one hour of time, it was possible to investigate some 42 different sets of operating conditions for the tower. These investigations were preliminary in nature but were of sufficient accuracy to permit the engineer to restrict his thorough investigation and detailed examination to those areas of operation that looked most promising.

The one plate-to-plate solution involved something in the order of four hours of computer time. The calculation procedure followed in the plate-to-plate calculation is a successive approximation method. This particular problem had a slow convergence on the correct compositions. This made computing time more lengthy than normal. A better average for a system of this nature might be something in the order of 2 to 2½ hours of computing time. In any event, it is easily seen that the plate-to-plate calculations are much more time consuming, and consequently, more expensive. For this reason, it is always wise to use the short-cut deck as a preliminary to the use of the more detailed plate-to-plate calculation procedure.

These computing times are roughly comparable in terms of dollars or cost. From this it can be seen that a great deal of machine time, as well as engineering time, can be saved by the proper utilization and combination of the two programs. The short-cut type calculations permit investigation of areas that are of marginal interest. At the same time, they give a much better idea of the area of operation that is apt to be most promising. The design of a distillation column is no different than any other design problem, in that the final decision will be made on the basis of cost, rather than proper engineering operation. However, it would not be too difficult to attach a dollar significance to the results of these calculations.

A great deal of engineering and computing time can be saved by proper utilization of approximation techniques and the more rigorous, detailed, analytical calculations. Each is valuable and when used correctly can provide a quick and accurate distillation tower design.

Nomenclature

α = relative volatility.
I = term in minimum reflux equation. ($I_L = Z_L/\alpha_L$, $I_H = Z_H$, $I_{LK} = Z_{LK}$ or Z_{LK}/α_{LK} depending on feed vaporization.)
R_m = minimum reflux ratio $(O/D)_m$.
S_m = minimum number of theoretical plates.
X = mole fraction of component in liquid.
Z = ratio of feed compositions.

Subscripts

D = distillate or overhead product.
H = heavy components.
HK = heavy key components.
L = light components.
LK = light key component.
W = bottoms product.

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No catalog or catalog-directory can describe all of the thousands of products and services used in the petroleum processing industries. By referring to these pages, however, you will find out who the manufacturers are for more than 1200 classifications. As a courtesy to our advertisers, check marks (✓) have been placed wherever their name appears. In many instances their advertisements will provide additional useful data. Guide to advertising content will be found on page A-6.

FUNCTIONAL DIRECTORY OF PRODUCTS AND SERVICES C-21

CONSTRUCTION MATERIALS C-24

ELECTRICAL EQUIPMENT C-24

FURNACES, HEATERS AND STEAM BOILERS C-25

HEAT EXCHANGE EQUIPMENT C-26

INSTRUMENTS AND CONTROL EQUIPMENT C-26

MATERIALS HANDLING EQUIPMENT C-30

ELECTRICAL MOTORS, TURBINES AND COMBUSTION ENGINES C-31

PIPE AND TUBING C-32

PIPE FITTINGS, VALVES AND ACCESSORIES C-32

PROCESS VESSELS AND EQUIPMENT C-37

PUMPS, COMPRESSORS AND BLOWERS C-39

SAFETY AND FIRE PROTECTION EQUIPMENT C-41

STORAGE TANKS AND ACCESSORIES C-41

TOOLS AND WELDING EQUIPMENT C-42

WATER TREATING EQUIPMENT C-42

CHEMICALS AND CATALYSTS C-44

LABORATORY EQUIPMENT AND INSTRUMENTS C-45

SERVICES — MAINTENANCE, ENGINEERING, R&D C-45

ENGINEERING-CONSTRUCTION CONTRACTORS C-46

REFINING PROCESS LICENSES C-48

PETROCHEMICAL PROCESS LICENSES C-48

COMPANY DIRECTORY — OFFICES AND PERSONNEL C-49

SUPPLEMENTARY LISTINGS — COMPANIES, PRODUCTS AND SERVICES C-113

CONTENTS OF FUNCTIONAL DIRECTORY

A

Accessories — Materials Handling C-30
Accessories — Motors & Engines C-31
Accumulators C-41
Acetic Acid C-44
Acid Inhibitors C-44
Acid Resisting Brick C-24
Acid Resisting Cement C-24
Acid Tanks C-41
Acids C-44
Additives C-44
Adhesives C-44
Adsorption Compounds C-44
Adsorption Systems — Gas C-38
Aerating Devices C-37
Agitators & Mixers C-38
Air Conditioners C-26
Air Coolers & Condensers C-26
Air Driven Motors C-31
Air Filters C-38
Air Preheaters C-26
Air Tools C-42
Air Traps C-33
Alarms & Annunciators C-26
Alarms — Fire & Temperature C-41
Alcohols C-44
Aldehydes C-44
Aluminum C-24
Aluminum Pipe & Tubing C-32
Amines C-44
Ammonia C-44
Amplifiers C-24
Analog Computers C-29
Analytical Instruments C-45
Analytical Laboratories C-45
Analytical Reagents C-45
Angle Valves C-33
Anodes — Corrosion Protecting C-24
Antifoaming Agents C-44
Apparatus — Laboratory C-45
Arches & Tube Supports C-25
Asbestos Pipe C-32
Atmospheric Storage Tanks C-41
Autoclaves C-37
Automatic Cutting Torches C-42
Automatic Controllers & Regulators C-26
Automatic Shutoff Valves C-33
Automatic Titration C-45

B

Ball & Swing Joints C-33
Ball Valves C-33
Barium Hydroxide C-45
Barometric Condensers C-26
Bearings C-31
Belting — Conveyor C-30
Bending Machines C-42
Beveling Machines C-42
Bitumens Linings C-24
Blending Equipment C-37
Blowers C-39
Boiler Feedwater Treating Chemicals C-42
Bolted Tanks C-41
Bombs — Sample C-45
Brass C-24
Brass Pipe C-32
Breathers — Tank C-42
Breathing Apparatus C-41
Brick C-24
Bronze C-24
Bubble Caps C-39
Burners — Industrial C-25
Butterfly Valves C-33

C

Cable & Wire — Electrical C-24
Cable & Wire Rope C-24
Calibration Equipment C-28
Calcium Hydroxide C-45
"Canned" Pumps C-39
Carbon Analyzers C-45
Carbon Monoxide Boilers C-25
Cartridge Filters C-38
Cast Iron Pipe C-32
Castings & Forgings C-24
Catalyst Carriers C-44
Catalysts C-44
Catalyst Screens C-39
Catalytic Cracking C-44
Catalytic Reforming C-44
Cement C-24
Cement Additives C-24
Cement Pipe C-32
Centrifugal Compressors C-39
Centrifugal Pumps C-39
Ceramic Linings C-24
Ceramic Pipe C-32
Ceramic Valves C-33
Chain C-30
Chain Hoists C-31
Check Valves C-33
Chemicals C-44
Chemical Desalters C-38
Chemical Feeders C-37
Chemical Fuels & Additives C-44
Chlorinated Hydrocarbons C-44
Chlorinators C-42
Chromatographs C-28
Circuit Breakers & Interrupters C-24
Clam Shells & Drag Lines C-31
Clarifiers & Thickeners C-37
Classification Equipment C-38
Clays & Earths C-44
Cleaning Compounds C-44
Cleaning Units C-42
Clothing — Protective C-41
Clutches C-31
Coalescers C-37
CO Boilers C-25
Colorimeters C-28
Columns — Distillation, Etc. C-37
Cooling Coils C-26
Cooling Tower Accessories C-26
Cooling Tower Fans C-26
Cooling Towers C-26
Combustion Control Systems C-28
Communications Equipment C-24
Compression Fittings C-33
Compressors C-39
Computer Components C-29
Condensers C-26
Condensers — Electric C-25
Conductivity — Electrical C-28
Conductivity — Thermal C-28
Conduit — Electrical C-25
Construction Contractors C-46
Consultants — Engineering C-46
Contactors & Relays C-25
Continuous Analyzers C-28
Continuous Samplers C-30
Control Systems & Instruments — Power C-25
Control Valves C-28, 33
Converters C-25
Conveyors C-30
Conveyor Parts C-30
Copper C-24
Copper Tubing C-32
Corrosion Inhibitors C-44
Counters, Integrators & Totalizers C-29
Cresylic Acid C-44
Crushers & Pulverizers C-38
Cranes C-31
Custom Chemicals C-44
Cutting & Brazing Torches C-42
Cutting & Threading Machines C-42
Cyclones & Dust Collectors C-37

D

Data Loggers C-29
Data Processing C-45
Deaerators C-42
Decking & Grating C-24
Deep Well Pumps C-39
Dehumidifiers C-26
Dehydrators C-38
Demisters — Wire Mesh C-39
Demulsifiers C-44
Desalters C-38
Desalting Chemicals C-44
Design & Engineering C-45
Desulfurization Units C-38
Detergents C-44
Dew Point Analyzers C-28
Diaphragm Valves C-33
Diesel Engines C-31
Digital Computers C-29
Distributors of Laboratory Equipment C-45
Double Pipe Heat Exchangers C-26
Draft Controllers C-26
Drain Valves — Tank C-42
Driers C-38
Drilling Machines C-42
Drives C-31
Drying Agents C-44
Dual Fuel Engines C-31
Dust Collectors C-37

E

Ejectors C-38
Electrical Conduit C-25
Electric Fittings C-25
Electric Generators C-25
Electric Motors C-31
Electrodes — Welding C-42
Electronic Computers C-29
Electronic Control Systems C-29
Electronic Instruments C-28
Emulsion Separators C-39
Engineering — Construction Contractors C-46
Engineering Consultants C-46
Engines C-31
Engine Starters C-31
Esters C-44
Ethanolamines C-44
Ethers C-44
Evaporators C-38
Exhaust Fans C-39
Expansion Joints C-32
Extinguishing Agents C-41
Extinguishers C-41
Extractors — Centrifugal C-38

F

Face Shields C-41
Fans C-39
Fans — Air Cooler C-26
Ferro — Nickel C-24
Fiberglass & Glass Linings C-24
Filtering Aids C-44
Filter Material C-38
Filters C-38
Finned Tubing C-26
Fire Fighting Equipment C-41
Fire Hose C-41
Fitting — Pipe C-33
Fittings — Flexible Hose C-32
Fittings & Receptacles — Explosion Proof C-25
Flame Arrestors C-41
Flanges C-32
Flexible Hose C-32
Float Switches C-30
Float Valves C-33
Flow Controllers C-26
Flow Meters C-29
Flow Nozzles C-29
Flue Gas Analyzers C-28
Fluid Density Analyzers C-28
Fluorine Compounds C-45
Flow Recorders & Indicators C-29
Flow Transducers C-30
Flux — Welding C-42
Foam Towers & Systems C-41
Forced Draft Fans C-39
Forced Feed Lubricators C-42
Fuel Oil Pumps C-39
Furfural C-45
Furnace Enclosures C-25
Furnace Tube Cleaning Units C-42

G

Gage & Instrument Valves C-37
Gage Glasses C-29
Gages & Gage Testers C-45
Gages — Pressure C-29
Gages — Tank C-42
Galvanized Pipe & Tubing C-32
Gas Burners C-25
Gas Compression Refrig. Units C-41
Gas Engines C-31
Gases — Compressed C-42
Gas Generators, Inert C-38
Gaskets & Mech. Packing C-32
Gas Odorants C-44
Gasoline Engines C-32
Gas Plants — Portable C-38
Gas Processing Equipment C-38
Gas Processing Plants C-46
Gas Traps C-33
Gas Turbines C-32
Gate Valves C-37
Gears C-31
General Maintenance Service C-46
General Purpose Recorders C-29
Generators — Electric C-25
Generators — Steam C-25
Glass Heat Exchangers C-26
Glass Pipe C-32
Glassware — Laboratory C-45
Globe Valves C-37
Glycols & Glycerines C-45
Goggles C-41
Governors — Engine C-32
Grease Manufacturing Equipment C-38
Grids C-39
Gunite Linings C-24
Guniting & Cementing C-46

H

Hand Tools C-42
Hatches — Tank C-42
H/C Analysis C-45
Heat Exchanger Cleaning Units C-42
Heat Exchanger Tubing C-26
Heat Exchangers C-26
Heaters — Electrical C-25
Heating Coils C-26
Heating Systems & Units C-26
Helmets C-41
Hoists C-31
Hose C-32, C-42
Hose Fittings C-32
Humidifiers C-26
Humidity Measurement C-28
Hydraulic Cranes C-31
Hydraulic Pumps C-39
Hydraulic Valves C-28
Hydrochloric Acid C-44
Hydrofluoric Acid C-44
Hydrogen Sulfide Removal Units C-38
Hydrometers C-45
Hydroxides C-45

I

Igniters & Pilots C-25
Ignition Systems C-31
Industrial Gases C-45
Industrial Plants C-46
Inert Gas Generators C-38
Infra-Red Indicator-Recorder C-28
Injectors C-38

INDEX OF PRODUCTS AND SERVICES

Inorganic Salts C-45
Instrument Maintenance ... C-46
Instrument Tubing C-30
Insulating Materials C-24
Insulation Installation C-46
Isomerization C-48

J

Jacketing — Aluminum C-24
Jet Ejector Condensers C-26
Jet Pumps C-39
Joints — Expansion C-32

K

Kilns — Rotary C-25

L

Laboratory Bath C-45
Laboratory Equipment C-45
Laboratory Ovens & Furnaces C-45
Laboratory Specialties C-45
Level Controls C-28
Level Indicators C-29
Level Measurement C-29
Lighting — Explosion Proof .. C-25
Limit Switches C-30
Line Blinds C-37
Line Strainers C-33
Linings — Pipe & Vessel ... C-24
Liquid Cyclones C-39
Liquid-Gas Separators C-39
Loaders C-31
Loading Arms C-31
Loading Hose C-31
Loading Platforms & Racks .. C-31
LP-Gas Systems C-33
Lubricating Equipment C-42

M

Magnetic Switches C-30
Magnetos C-31
Maintenance & Repair Services C-46
Manometers C-29
Mechanical Packing C-32
Mechanical Seals C-39
Metal Hose C-32
Metalizing — Metal Spraying C-46
Metal Linings C-24
Metallo-Organic Compounds C-45
Metals & Alloys in Mill Forms C-24
Metals Inspection C-46
Metals Inspection Analyzers .. C-28
Meter Housings C-29
Metering Pumps C-41
Metering Separators C-39
Methanol C-44
Microphotometers C-45
Microwave Communications .. C-24
Mist Separators C-39
Mixers & Agitators C-38
Mixing Units — Cement C-24
Moisture Analyzer C-28
Molybdenum C-24
Monitors C-41
Motor Control Centers & Starters C-25
Motor-operated Valves C-28
Motors — Electrical C-31
Mufflers & Silencers C-31
Multiple Hearth Furnaces C-25

N

Needle Valves C-37
Nephelometers C-45
Nickel C-24
Nickel Alloys C-24
Nitric Acid C-44
Nitrogen C-45
Nozzles C-41

O

Oil Burners C-25
Orifice Fittings & Plates C-29
Orifice Meters C-29
Oxygen C-45
Oxygen Analyzer C-28

P

Packing — Tower C-39
Paints & Coatings C-24
Panel Boards C-29
Petrochemical Processes C-48
Phenol C-45
pH Meters C-28
Pinch Valves C-37
Pipe & Tubing C-32
Pipe & Tubing Coils C-26
Pipe Coils & Bends C-32
Pipe Fabrication C-46
Pipe Fittings C-33
Pipeline Wrapping Tapes C-24
Pipe Machinery C-42
Pipe Saddles C-42
Pipe Wrenches C-42
Plastic & Rubber Linings C-24
Plastic Fittings C-33
Plasticizers C-45
Plastic Pipe & Tubing C-32
Plastic Pumps C-39
Plastics & Rubber C-45
Plastic Sheet & Structures C-24
Plastic Valves C-37
Plug Valve Lubricators C-42
Plug Valves C-37
Plunger Pumps C-39
Pneumatic Tools C-42
Portable Compressors C-39
Portable Gas Plants C-38
Portable Pumps C-39
Portland Cement C-24
Potassium Hydroxide C-45
Potentiometers C-28
Power Shovels C-31
Prefabricated Pipe C-32
Pressure Controls C-28
Pressure Gages C-28
Pressure Regulators ... C-37, C-42
Pressure Switches C-30
Pressure Vessels C-38
Process Furnaces & Heaters .. C-25
Processing Equipment — Wooden C-38
Process Research C-46
Product Research C-46
Proportioning Pumps C-41
Protective Clothing C-41
Pulsation Dampeners C-33
Pulverizers & Crushers C-38
Pumping Station Construction .. C-46
Pumps C-39
Pyrometers C-30

R

Radiochemicals C-45
Radio Communications Systems C-24
Radiological Inspection Equipment C-28
Radiological Measurement C-28
Reactors C-38
Reciprocating Compressors ... C-39
Reciprocating Pumps C-41
Recorders & Indicators C-29
Recording Charts & Supplies .. C-30
Rectifiers C-25
Refinery Construction C-48
Refining Process Licenses C-48
Refractometers C-28
Refractories C-25
Refractory Brick C-24
Refractory Cement C-24
Refractory Linings C-24
Refrigeration Machinery C-41
Regulators—Voltage C-25
Relays C-25
Relief Valves C-37
Relief Valves — Tank C-42
Reodorants C-44
Repair Patches C-33
Repair Services C-46
Research & Development C-46
Resins C-45
Resistance Wire C-24
Rheostats C-25
Risers & Chimneys C-39
Rotameters C-29
Rotary Kilns C-25
Rotary Meters C-29
Rotary Positive Compressors .. C-39
Rotary Positive Pumps C-41
Rubber Hose C-32

S

Safety & Relief Valves C-37
Safety Equipment C-41
Safety Heads C-38
Salts — Inorganic C-45
Sample Bombs C-45
Samplers, Continuous C-30
Sand Blasting C-46
Screening & Classification Equipment C-38
Screw Pumps C-41
Scrubbers C-38
Sealing Compounds C-33
Separators C-39
Services C-45
Sheaves C-31
Shell & Tube Heat Exchangers C-26
Shovels, Power C-31
Slip Joints C-33
Slurry Pumps C-41
Smoke Density Measurement .. C-28
Soda Ash C-45
Sodium Hydroxide C-45
Solenoids C-25
Solvents C-45
Spark Plugs C-31
Special Corrosion Resisting Alloys C-24
Specific Gravity C-28
Spectrographic Analyzers C-28
Spectrophotometer C-45
Spheres C-41
Sprays — Metalizing C-46
Sprinkler Systems C-41
Sprockets C-31
Stabilizers C-45
Stairways C-24
Steam & Power Plant Construction C-48
Steam Boilers & Generators .. C-25
Steam Condensers C-26
Steam Engines C-32
Steam Generators C-26
Steam Separators C-39
Steam Traps C-33
Steam Turbines C-32
Steel, Low Alloy C-24
Steel, Stainless C-24
Storage Tank Construction ... C-48
Storage Tanks C-41
Strainers — Line C-33
Substations C-25
Sulfur C-45
Sulfur Burners C-25
Sulfuric Acid C-44
Sulfur Recovery Units C-38
Sump Pumps C-41
Surface Condensers C-26
Swing Joints C-33
Switches — Control C-30
Switchgear C-25

T

Tachometers C-30
Tanks, Storage C-41
Telemetering C-24
Telephone Systems C-25
Television — Industrial C-25
Temperature Controls C-28
Temperature Recorders & Indicators C-30
Temperature Switches C-30
Test Equipment—Electrical ... C-25
Tetraethyl Lead C-44
Thermocouples C-30
Thermometers C-30
Thickeners C-37
Timing Devices C-30
Timing Switches C-30
Titanium C-24
Torches — Cutting C-42
Totalizers C-29
Tower Internals C-39
Tractors C-31
Transducers C-30
Transformers C-25
Transmissions C-31
Transmitters C-30
Traps C-33
Trays — Distillation C-39
Treating & Sweetening Equipment C-39
Trenchers C-31
Trickle Valves C-37
Trucks & Carriers C-31
Tube Benders C-42
Tube Expanders C-42
Tubing C-32
Tubing Cutters C-42
Tubing — Finned C-26
Tubing Fittings C-33
Tubing — Heat Exchanger .. C-26
Tubing — Instrument C-30
Turbine Pumps C-41

U

Unions C-33

V

Vacuum Gages C-29
Vacuum Pumps C-41
Vacuum Systems & Equipment C-39
Valve Control Switches C-30
Valve Positioners C-30
Valves C-33
Vaporizers C-37
Vapor Pressure Measurement . C-28
V-Belts C-31
Venturis C-29
Vent Valves C-42
Viscometers C-45
Viscosity Analyzers C-28
Voltage Regulators C-25
Volume Meters C-29

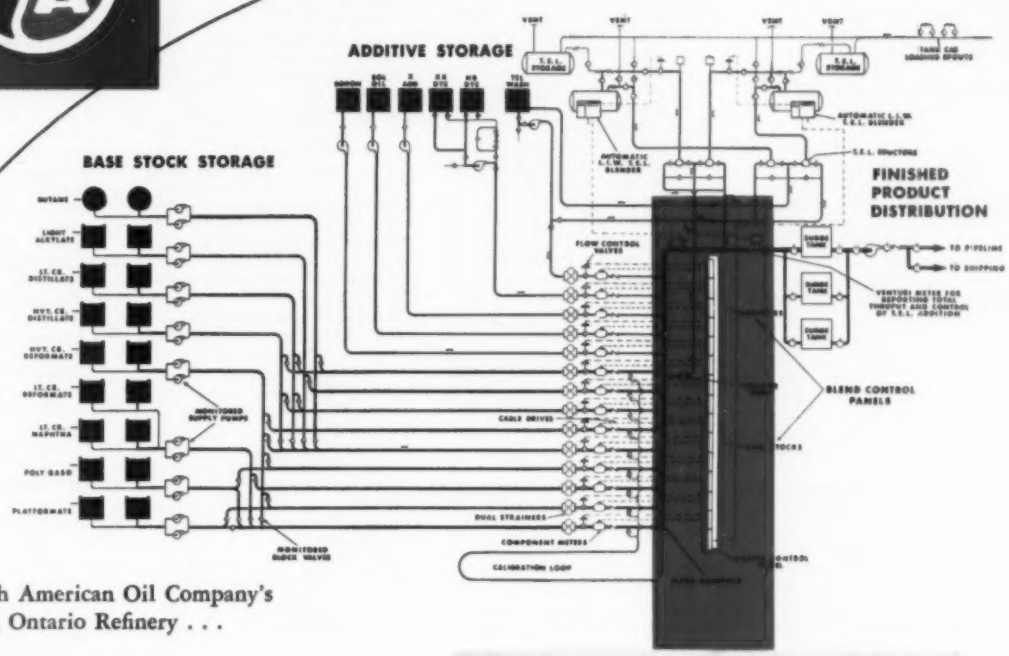
W

Walkways C-24
Waste Water Separators ... C-44
Water Analyzers — Electrolytic C-45
Water Separators C-39
Water Softening Units C-44
Water Tanks C-42
Water Treating Chemicals ... C-42
Water Treating Equipment .. C-44
Water Treating Plant Construction C-48
Wax Sweaters C-39
Welders — Electric C-42
Welders — Inert Gas C-42
Welding Equipment C-42
Welding Fittings C-33
Welding Rods C-42
Winches C-31
Wire Cloth & Mesh C-24
Wire Mesh Demisters C-39
Wire Rope C-24
Wooden Processing Equipment C-39
Wood Pipe C-32
Wrapping Tapes — Pipeline . C-24

Z

Zeolites C-42
Zirconium C-24

POSITIVE CONTROL OF MATERIALS IN MOTION



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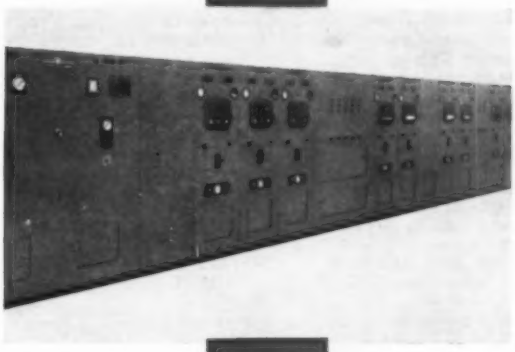
Tailor-made hydrocarbon blends at the twist of a dial!



As market demands change, so too do the number and nature of base stocks, dyes, additives, and TEL involved in gasoline production. British American meets these demands with the greater operational flexibility found in a Proportioneers Continuous Automatic Blending System. This system provides twist-of-a-dial, tailor-made products . . . minimizes intermediate tankage . . . and offers many design and economic features keyed to the production tempo of today . . . *and tomorrow!*

Proportioneers equipment *continuously* proportions and mixes the components . . . in proper ratio to each other and end-product demands . . . and provides safeguards to compensate for any upset. Blender operation, based on the *closed control loop,* constantly meters each stream, compares this signal with an established condition, and automatically makes any flow rate adjustments required.

Keep pace with progress by requesting complete data on this system. Write **Proportioneers, Inc., 442 Harris Avenue, Providence 1, Rhode Island.**

PROPORTIONEERS
DIVISION OF
B-I-F INDUSTRIES
METERS
FEEDERS
CONTROLS

Functional Directory of Products and Services

Construction Materials—Structural Metals, Insulation, Coatings, etc.

ANODES, CORROSION PROTECTING
Cathodic Protection Service

BRICK

Acid-Resisting Brick
Carter-Waters Corp.
Johns-Manville Corp.
United States Stoneware Co.

Refractory Brick
Carter-Waters Corp.
Johns-Manville Corp.
Kaiser Alum. & Chem. Sales, Inc.
Norton Company
Walsh Refractories Corp.

CABLE AND WIRE ROPE
American Chain & Cable Co., Inc.
Jones & Laughlin Steel Corp.
United States Steel Corp.
Youngstown Sheet & Tube Co.

CASTINGS AND FORGINGS
Alco Products Co.
Allegheny Ludlum Steel Corp.
Harvey Aluminum
Kaiser Alum. & Chem. Sales, Inc.
Kennametal, Inc.
Lukens Steel Co.
U.S. Pipe & Foundry Co.
U.S. Steel Corp.

CEMENT

Acid-Resisting Cement
United States Stoneware Co.
Universal Atlas Cement Co.

Cement Additives
Dewey & Almy Chemical Co.

Mixing Units
Ingersoll Kalamazoo Div.

Portland Cement
United States Rubber Co.
United States Steel Corp.
Universal Atlas Cement Co.

Refractory Cement
Carter-Waters Corp.
Eagle-Picher Co.
Johns-Manville Corp.
Mexico Refractories Co.
Norton Co.
Geo. P. Reintjes Co.
United States Steel Corp.
United States Stoneware Co.
Universal Atlas Cement Co.
Walsh Refractories Corp.

DECKING AND GRATING
Borden Metal Products Co.
Dravo Corp.
Hendrick Manufacturing Co.
Irving Subwy Grating Co., Inc.
Jones & Laughlin Steel Corp.
Klemp Metal Grating Corp.
Texas Tank, Inc.
United States Steel Corp.

INSULATING MATERIALS
American Gilsonite Co.
Armstrong Cork Co.
Barrett Div., Allied Chem. & Dye
Cathodic Protection Service
Eagle-Picher Co.
Ehret Magnesia Mfg. Co.
✔ General Electric Co.
B. F. Goodrich Co.
Johns-Manville Corp.
L-O-F Glass Fibers Co.
Owens-Ill. Glass Co., Kaylo Div.
Pabco Ind. Ins. Div., Fibreboard Paper Prods. Corp.
✔ Union Asbestos & Rubber Co.
United States Rubber Co.

JACKETING — ALUMINUM
Aseeco, Inc.
Aluminum Company of America
Childers Manufacturing Co.
Eagle-Picher Co.
Harvey Aluminum

LININGS — PIPE AND VESSEL

Bitumens Linings
American Pipe & Constr. Co.
Barrett Div., Allied Chem. & Dye
Lion Oil Co.
Pittsburgh Coke & Chem. Co.

Ceramic Linings
United States Stoneware Co.

Fiberglass and Glass Linings
L-O-F Glass Fibers Co.
✔ National Tank Co.

Gunite Linings
American Pipe & Constr. Co.
Emjay Maintenance Engineers
Patterson-Kelley Co., Inc.
✔ Pipe Linings, Inc.
United States Stoneware Co.
Universal Atlas Cement Co.

Metal Linings
American Sand-Banum Co., Inc.
Haynes Stellite Co.
Heil Process Equipment Corp.
National Lead Co.
Arthur Tickle Engr. Works, Inc.
U.S. Pipe & Foundry Corp.
United States Steel Corp.

Plastic and Rubber Linings
Amercoat Corp.
Carboline Co.
Gates Engineering Co.
✔ Glidden Co.
B. F. Goodrich Co.
Heil Process Equipment Corp.
Industrial Filter & Pump Mfg. Co.
Johns-Manville Corp.
Koppers Co.
✔ National Tank Co.
Plastic Applicators, Inc.
Raybestos-Manhattan, Inc.
Tube-Kote, Inc.
United States Rubber Co.
Wilbur & Williams Co.

Refractory Linings
Geo. P. Reintjes Co.

Wrapping Tapes, Pipeline
American Pipe & Constr. Co.
L-O-F Glass Fibers Co.
Kendall Co., Polyken Div.

METALS AND ALLOYS IN MILL FORMS

Aluminum
Aluminum Company of America
Bridgeport Brass Co.
Harvey Aluminum
Kaiser Alum. & Chem. Sales, Inc.
United States Steel Corp.

Brass
Bridgeport Brass Co.
Chase Brass & Copper Co., Inc.
Phelps Dodge Copper Prod. Corp.

Bronze
Chase Brass & Copper Co., Inc.

Copper
Ampco Metal, Inc.
Bridgeport Brass Co.
Chase Brass & Copper Co., Inc.
Phelps Dodge Copper Prod. Corp.

Ferro-Nickel
Allegheny Ludlum Steel Corp.
American Nickel Alloy Mfg. Co.
✔ Babcock & Wilcox Co.
✔ International Nickel Co.
Youngstown Sheet & Tube Co.

Molybdenum
Climax Molybdenum Co.

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American Nickel Alloy Mfg. Corp.
✔ Babcock & Wilcox Co.
Haynes Stellite Co.
✔ International Nickel Co., Inc.
Youngstown Sheet & Tube Co.

Special Corrosion-Resisting Alloys
Haveg Corp.
Haynes Stellite Co.
Kennametal, Inc.
United States Steel Corp.

Stainless Steel
Allegheny Ludlum Steel Corp.
American Nickel Alloy Mfg. Co.
✔ Babcock & Wilcox Co.
Chase Brass & Copper Co., Inc.
Crucible Steel Co. of America
✔ International Nickel Co.
United States Steel Corp.
Youngstown Sheet & Tube Co.

Steel, Low Alloy
Allegheny Ludlum Steel Corp.
✔ Babcock & Wilcox Co.
Baldwin-Lima-Hamilton Corp.
✔ J. B. Beaird Co.
Bethlehem Steel Co.
Crucible Steel Co. of America
Harvey Aluminum
Jones & Laughlin Steel Corp.
Lukens Steel Co.
Republic Steel Corp.
United States Steel Corp.
Youngstown Sheet & Tube Co.

Titanium
Harvey Aluminum

Zirconium
Allegheny Ludlum Steel Corp.

PAINTS AND COATINGS
Amercoat Corp.
American Sand-Banum Co., Inc.
Barrett Div., Allied Chem. & Dye
Carboline Co.
Carter-Waters Corp.
Cathodic Protection Service
Celanese Corp. of America
Dow Corning Corp.
Gates Engineering Co.
✔ General American Transport. Corp.
✔ Glidden Co.
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Johns-Manville Corp.
Kendall Co., Polyken Div.
Lion Oil Co.
L-O-F Glass Fibers Co.
Magnus Chemical Co., Inc.
Mexico Refractories Co.
Pittsburgh Coke & Chem. Co.
✔ Rust-Oleum Corp.
Silicones Div., Union Carb. Corp.
Nowery J. Smith Co.
Spee-Flo Co.
Arthur Tickle Engr. Works, Inc.
Tube-Kote, Inc.
United States Rubber Co.
United States Steel Co.
United States Stoneware Co.
Wilbur & Williams Co.

PLASTIC SHEET AND STRUCTURES
Carter-Waters Corp.
Gates Engineering Co.
B. F. Goodrich Co.
Heil Process Equipment Corp.
L-K Pump Valve Co.
Mexico Refractories Co.
✔ National Tank Co.
United States Rubber Co.

PIPE AND TUBING
See Pipe and Tubing Section

SCAFFOLDING MATERIALS
Patent Scaffolding Co., Inc.

WALKWAYS AND STAIRWAYS
Black, Sivalls & Bryson, Inc.
Columbian Steel Tank Co.
Dravo Corp.
Irving Subwy. Grating Co., Inc.
Klemp Metal Grating Corp.
✔ National Tank Co.
United States Steel Corp.

WIRE CLOTH AND MESH
Carter-Waters Corp.
United States Steel Corp.
Otto H. York Co., Inc.

Electrical Equipment

CABLE AND WIRE
Chase Brass & Copper Co., Inc.
General Cable Corp.
✔ General Electric Co.
Okonite Co.
Phelps Dodge Copper Prod. Corp.
Rome Cable Corp.
United States Steel Corp

Resistance Wire
General Cable Corp.

CIRCUIT BREAKERS AND INTERRUPTERS
Allis-Chalmers Mfg. Co.
Cutler-Hammer, Inc.
✔ General Electric Co.
✔ Nelson Electric Mfg. Co.
Pyle-National Co.
Square D Co.
Westinghouse Electric Corp.

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Bendix Aviation Co.
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Epsco, Inc.
Fielden Instrument Div.
✔ General Electric Co.
Hammarlund Mfg. Co.
Westinghouse Electric Co.
Taber Instrument Corp.

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Automatic Electric Sales Corp.
Hammarlund Mfg. Co.
Philco Corp.
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Automatic Electric Sales Corp.
✔ General Electric Co.
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Telemetering
Applied Science Corp. of Princeton
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Telephone Systems
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✔ General Electric Co.
Westinghouse Electric Co.

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Allis-Chalmers Mfg. Co.
✔ General Electric Co.
Westinghouse Electric Corp.

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

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Automatic Elec. Sales Corp.
Automatic Switch Co.
Esco Manufacturing Co.
✔ General Electric Co.
Precision Thermometer & Instr. Co.
Square D Co.
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Weston Electric Instr. Corp.

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Applied Science Corp. of Princeton
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General Controls Co.
✔ General Electric Co.
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CONVERTERS
Allis-Chalmers Mfg. Co.
Epsco, Inc.
✔ General Electric Co.
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ELECTRICAL CONDUIT
Flexible
General Cable Corp.
Rome Cable Corp.
Rigid
General Cable Corp.
Rome Cable Corp.

FITTINGS AND RECEPTACLES — EXPLOSION PROOF
Appleton Electric Co.
Crouse-Hinds Co.
✔ General Electric Co.
Pyle-National Co.
Titeflex, Inc.

GENERATORS — AC AND DC
Allis-Chalmers Mfg. Co.
Carrier Corp.
Century Electric Co.
Electric Machinery Mfg. Co.
✔ General Electric Co.
Hobart Brothers Co.
Murphy Diesel Co.
Narda Ultrasonics Corp.
Peerless Electric Co.
Pyle-National Co.
Westinghouse Electric Corp.
Worthington Corp.

HEATERS — ELECTRICAL
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✔ General Electric Co.
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Hynes Elec. Heat. Div., Turbine Equip. Co.
Westinghouse Electric Co.

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✔ General Electric Co.
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Westinghouse Electric Corp.

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Automatic Switch Co.
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Electric Machinery Mfg. Co.
✔ General Electric Co.
✔ Nelson Electric Mfg. Co.
Square D Co.
Westinghouse Electric Corp.
Worthington Corp.

MOTORS — ELECTRICAL
See Motors and Engines Section

RECTIFIERS
Allis-Chalmers Mfg. Co.
Cathodic Protection Service
✔ General Electric Co.
Westinghouse Electric Co.

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Allis-Chalmers Mfg. Co.
Electric Machinery Mfg. Co.
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Cutler-Hammer, Inc.
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Automatic Switch Co.
Cutler-Hammer, Inc.
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Esco Manufacturing Co.
✔ General Electric Co.
Westinghouse Electric Corp.

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Allis-Chalmers Mfg. Co.
Applied Science Corp. of Princeton
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Electric Machinery Mfg. Co.
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B J Electronics
Cathodic Protection Service
Peschel Electronics, Inc.

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Cutler-Hammer, Inc.
✔ General Electric Co.
Potter Instrument Co., Inc.

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Allis-Chalmers Mfg. Co.
Esco Manufacturing Co.
✔ General Electric Co.
Westinghouse Electric Corp.
Weston Electric Instr. Corp.

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Geo P. Reintjes Co.

BURNERS — INDUSTRIAL
Coke and Coal — Pulverized
Allis-Chalmers Mfg. Co.
✔ Babcock & Wilcox Co.
Erie City Iron Works
Combination Gas and Oil
✔ Babcock & Wilcox Co.
Eclipse Fuel Engineering Co.
Erie City Iron Works
National Airoil Burner Co.
Ray Oil Burner Co.
Thermal Research & Engr. Corp.
John Zink Mfg. Corp.
Gas Burners
Allis-Chalmers Mfg. Co.
✔ Babcock & Wilcox Co.
Cleaver-Brooks Co.
Eclipse Fuel Engineering Co.
Erie City Iron Works
Handley-Brown Heater Co.
Iron Fireman Mfg. Co.
National Airoil Burner Co.
✔ O T M Corp.
Ray Oil Burner Co.
Selas Corporation of America
Thermal Research & Engr. Corp.
John Zink Mfg. Co.
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Allis-Chalmers Mfg. Co.
✔ Babcock & Wilcox Co.
Cleaver-Brooks Co.
Eclipse Fuel Engineering Co.
Erie City Iron Works
Gilbert & Barker Mfg. Co.
Iron Fireman Mfg. Co.
National Airoil Burner Co.
Ray Oil Burner Co.
Schutte & Koerting Co.
Thermal Research & Engr. Corp.
John Zink Mfg. Co.

SULFUR BURNERS
Schutte & Koerting Co.
John Zink Mfg. Co.

CONDENSATE RETURN SYSTEMS
Cochrane Corp.
Eclipse Fuel & Engr. Co.

CARBON MONOXIDE BOILERS
✔ Babcock & Wilcox Co.
Combustion Engineering, Inc.

CONTROL SYSTEMS
See Instruments and Controls Sec.

FUEL PUMPS
See Pumps and Compressors Sec.

FURNACE ENCLOSURES
Geo. P. Reintjes Co.
✔ O T M Corp.

IGNITERS AND PILOTS
Black, Sivalls & Bryson, Inc.
✔ Stitt Ignition Co.

KILNS, ROTARY
Allis-Chalmers Mfg. Co.

MULTIPLE HEARTH FURNACES
Nichols Engr. & Research Corp.

PROCESS FURNACES AND HEATERS
Alcorn Combustion Co.
K. W. Anderson Co.
✔ Born Engineering Co.
Brown Fintube Co.
Delta Tank Mfg. Co., Inc.
Dravo Corp.
Eclipse Fuel Engineering Co.
Erie City Iron Works
Foster Wheeler Corp.
Gilbert & Barker Mfg. Co.
M. W. Kellogg Co.
The Lummus Co.
Nichols Engr. & Research Corp.
N R C Equipment Corp.
O'Neill Tank Co., Inc.
✔ O T M Corp.
✔ Petro-Chem Dev. Co., Inc.
Schutte & Koerting Co.
Selas Corporation of America
Southwestern Engineering Co.
Struthers Wells Corp.
Thermal Research & Engr. Corp.
Whitlock Mfg. Co.
Yuba Consolidated Ind., Inc.

REFRACTORIES
Aluminum Company of America
✔ Babcock & Wilcox Co.
Bigelow Liptak Corp.
A. P. Green Fire Brick Co.
Johns-Manville Corp.
Kaiser Aluminum & Chemical Sales, Inc.
National Airoil Burner Co.
Geo. P. Reintjes Co.
True Gun-All Equipment Corp.
United States Steel Corp.
Walsh Refractories Corp.

REPAIR PARTS AND EQUIPMENT
Airetool Manufacturing Co.
National Airoil Burner Co.

Tubes
✔ Babcock & Wilcox Co.
Brown Fintube Co.
Electro-Alloys Div., American Brake Shoe Co.
U.S. Steel Corp., National Tube Div.

STEAM SEPARATORS
V. D. Anderson Co.
Hagan Chem. & Controls, Inc.
Metal Textile Corp.
✔ Peerless Mfg. Co.
Schutte & Koerting Co.
Yarnall-Waring Co.

STEAM BOILERS AND GENERATORS
Ames Iron Works, Inc.
✔ Babcock & Wilcox Co.
✔ Born Engineering Co.
Brown Fintube Co.
Cleaver-Brooks Co.
Combustion Engineering, Inc.
Eclipse Fuel Engineering Co.
Erie City Iron Works
Foster Wheeler Corp.
Gilbert & Barker Mfg. Co.
Griscom-Russell Co.
Lummus Co., The
✔ National Tank Co.
National U.S. Radiator Corp.
Ray Oil Burner Co.
Texas Chemical Engr. Co.
✔ Henry Vogt Machine Co.
Vulcan Steel Tank Corp.
✔ Wickes Boiler Co.
Yuba Consolidated Ind., Inc.

WATER TREATING EQUIPMENT AND SERVICE
See Water Treating Equipment Section

✔ *Advertisement in this issue. index is on page A-6.*

Heat Exchange Equipment

AIR-CONDITIONING AND HEATING EQUIPMENT

Air Conditioners
- American Blower Div.
- Carrier Corp.
- ✔ General Electric Co.
- National U.S. Radiator Corp.
- Trane Co.
- Westinghouse Electric Corp.
- Worthington Corp.
- Young Radiator Co.

Dehumidifiers
- Milton Roy Co.
- Pittsburgh Lectrodryer Div.
- Trinity Equipment Corp.
- Worthington Corp.

Heating Systems and Units
- ✔ General Electric Co.
- Grinnell, Inc.
- National U.S. Radiator Corp.
- Trane Co.
- Worthington Corp.

Humidifiers
- Worthington Corp.
- Young Radiator Co.

AIR COOLERS AND CONDENSERS
- Richard M. Armstrong Co.
- Carrier Corp.
- Croll-Reynolds Co., Inc.
- Dean Products, Inc.
- Degree Corp.
- Engineers & Fabricators
- Erie City Iron Works
- Frick Co.
- Goslin-Birmingham Mfg. Co.
- Graham Mfg. Co., Inc.
- Griscom-Russell Co.
- Happy Co.
- Hendrick Manufacturing Co.
- Hudson Engineering Corp.
- Manning & Lewis Engr. Co.
- National U.S. Radiator Corp.
- ✔ O T M Corp.
- Pittsburgh-Des Moines Steel Co.
- Ross Heat Exch. Div., American Rad. & Stand. Sanitary Corp.
- Schutte & Koerting Co.
- Southwestern Engineering Co.
- Struthers Wells Corp.
- Texas Metal Fab. Co., Inc.
- Trane Co.
- United States Steel Corp.
- Western Supply Co.
- Whitlock Manufacturing Co.
- Worthington Corp.
- Young Radiator Co.
- Yuba Consolidated Ind., Inc.

AIR PRE-HEATERS
- Erie City Iron Works
- Manning & Lewis Engr. Co.
- Schutte & Koerting Co.
- Whitlock Manufacturing Co.
- John Zink Manufacturing Co.

COOLING AND HEATING COILS

Pipe and Tubing Coils
- Alco Products, Inc.
- C F Braun & Co
- Brown Fintube Co.
- Condenser Serv. & Engr. Co., Inc.
- Frick Co.
- Griscom-Russell Co.
- Heil Process Equipment Corp.
- Midwest Piping Co., Inc.
- Trane Co.
- ✔ Henry Vogt Machine Co.
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- Yuba Consolidated Ind., Inc.

Plate Type
- Dean Products, Inc.
- Griscom-Russell Co.

COOLING TOWERS
- Carrier Corp.
- Degree Corp.
- Fluor Products Co.
- Griscom-Russell Co.
- Hendrick Manufacturing Co.
- Marley Co.
- ✔ O T M Corp.
- J. F. Pritchard & Co.
- Water Cooling Equipment Co.

COOLING TOWER ACCESSORIES
- Ned C. Stearns Co.

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Barometric Condensers
- Frick Co.
- Happy Co.
- ✔ Ingersoll-Rand Co.
- Lummus Co.
- Manning & Lewis Engr. Co.
- Ross Heat Exch. Div., American Rad. & Stand. Sanitary Corp.
- Schutte & Koerting Co.
- Whitlock Manufacturing Co.
- Worthington Corp.

Jet Ejector Condensers
- ✔ Ingersoll-Rand Co.
- Lummus Co.
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- Worthington Corp.

Steam Condensers
- Allis-Chalmers Mfg. Co.
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- Lummus Co.
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- Worthington Corp.

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- Southwestern Engineering Co.
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- Westinghouse Electric Co.
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- Whitlock Manufacturing Co.
- Wolverine Tube

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- C F Braun & Co
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- Carrier Corp.
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- Lummus Co.
- Manning & Lewis Engr. Co.
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- National U.S. Radiator Corp.
- ✔ O T M Corp.
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TUBING — HEAT EXCHANGERS

Finned Tubing
- Alco Products, Inc.
- ✔ Babcock & Wilcox Co.
- Brown Fintube Co.
- Griscom-Russell Co.
- Hudson Engineering Corp.
- National U.S. Radiator Corp.
- Reading Tube Corp.
- Schutte & Koerting Co.
- Wolverine Tube

Plain Tubing
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- Aluminum Company of America
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- Chase Brass & Copper Co., Inc.
- Copperweld Steel Co.
- Crucible Steel Co. of America
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- Jones & Laughlin Steel Corp.
- Kaiser Aluminum & Chemical Sales, Inc.
- Lewis-Mathes Co.
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- ✔ O T M Corp.
- Pacific Tube Co.
- Phelps Dodge Copper Prod. Corp.
- ✔ Scoville Manufacturing Co.
- Superior Tube Co.
- United States Steel Corp.
- Wolverine Tube

Instruments & Control Equipment

ALARMS AND ANNUNCIATORS
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- Thomas A. Edison Industries
- Foster Engineering Co.
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- Industrial Instrument Corp.
- Johnston & Jennings Co.
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- ✔ Magnetrol, Inc.
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- Bristol Co.
- Foxboro Co.
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- Indikon Co., Inc.
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- Republic Flow Meters Co.

Flow of Liquids and Gases
- ✔ American Meter Co.
- Applied Science Corp. of Princeton
- Askania Regulator Co.
- Atlas Valve Co.
- Bailey Meter Co.
- Baldwin-Lima-Hamilton Corp.
- Barber-Colman Co.
- Barton Instrument Corp.
- Bendix Aviation Corp.
- Black, Sivalls & Bryson, Inc.
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Republic Flow Meters Co.
Swartwout Co.
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Manning, Maxwell & Moore, Inc.
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Taylor Instrument Co.

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✔ International Harvester

TRENCHERS

Baldwin-Lima-Hamilton Corp.
J. I. Case Co.
Gar Wood Industries, Inc.
✔ Koehring Co.
Schield Bantam Co.
Sherman Products, Inc.

TRUCKS AND CARRIERS — INDUSTRIAL

Allis-Chalmers Mfg. Co.
Baker-Raulang Co.
Clark Equipment Co.
Delta Tank Mfg. Co., Inc.
Dempster Bros., Inc.
Fairbanks Co.
Gar Wood Industries, Inc.
Hyster Co.
Johnston & Jennings Co.
✔ Koehring Co.
Lufkin Foundry & Machine Co.
Sherman Products, Inc.
Texas Chemical Engineering Co.
Uhrden, Inc.

VIBRATING SCREENS

Hewitt-Robins Co.

WINCHES

Gar Wood Industries, Inc.
Shand & Jurs Co.
Shaw-Box Div., Manning, Maxwell & Moore, Inc.

Motors, Engines and Accessories

ACCESSORIES

Engine Starters and Starter Systems
Allis-Chalmers Mfg. Co.
American Bosch Arma Corp.
✔ General Electric Co.
Happy Co.

Exhaust Heads
V. D. Anderson Co.

Fuel Injection Systems
American Bosch Arma Corp.

Gears
Allis-Chalmers Mfg. Co.
Condenser Serv. & Engr. Co., Inc.
DeLaval Steam Turbine Co.
Diamond Chain Co., Inc.
✔ General Electric Co.
Johnson Gear & Mfg. Co., Ltd.
Link-Belt Co.
Lufkin Foundry & Machine Co.
Philadelphia Gear Works, Inc.
United States Rubber Co.
Western Gear Corp.
Westinghouse Electric Corp.

Ignition Systems
American Bosch Arma Corp.

Magnetos
American Bosch Arma Corp.

Mufflers and Silencers
Burgess-Manning Co.

Piston Rings — Industrial Engines
C. Lee Cook Co.
Koppers Co., Inc.

Sheaves
Allis-Chalmers Mfg. Co.
Happy Co.
Link-Belt Co.
Reeves Pulley Co.
Sauerman Bros., Inc.
United States Rubber Co.
Worthington Corp.

Spark Plugs
✔ Stitt Ignition Co.

Valves and Valve Plates
C. Lee Cook Co.

V-Belts
Allis-Chalmers Mfg. Co.
B. F. Goodrich Co.
Happy Co.
Link-Belt Co.
United States Rubber Co.
Worthington Corp.

AIR-DRIVEN MOTORS

Gardner-Denver Co.

DIESEL ENGINES

Alco Products, Inc.
Allis-Chalmers Mfg. Co.
Baldwin-Lima-Hamilton Co.
J. I. Case Co.
✔ Caterpillar Tractor Co.
✔ Cooper-Bessemer Corp.
✔ Ingersoll-Rand Co.
Jones & Laughlin Supply Div.
Murphy Diesel Co.
Nordberg Manufacturing Co.
Oil Well Supply Div., U.S. Steel Corp.
Worthington Corp.
✔ Curtiss Wright Corp.

ELECTRIC MOTORS (EXPLOSION AND/OR SPLASH PROOF)

Induction and Synchronous
Allis-Chalmers Mfg. Co.
Carrier Corp.
✔ Caterpillar Tractor Co.
Electric Machinery Mfg. Co.
Elliott Co.
✔ General Electric Co.
Jones & Laughlin Supply Div.
Peerless Electric Co.
Sterling Electric Motors, Inc.
✔ Valley Electric Corp.
Westinghouse Electric Corp.
Worthington Corp.

Direct Current
Allis-Chalmers Mfg. Co.
Elliott Co.
✔ General Electric Co.
Moore Co.
Peerless Electric Co.
Westinghouse Electric Corp.

Variable Speed
Allis-Chalmers Mfg. Co.
✔ General Electric Co.
Peerless Electric Co.
Sterling Electric Motors, Inc.
Westinghouse Electric Corp.

DRIVE COMPONENTS AND TRANSMISSIONS

Berry Hydraulics
Carrier Corp.
✔ Caterpillar Tractor Co.
Koppers Co., Inc.

Bearings
Chain Belt Co.
Link-Belt Co.

Clutches
Cutler-Hammer, Inc.

Cylinder and Piston Repair
Van Der Horst Corp.

Drives — Belt
Allis-Chalmers Mfg. Co.
B. F. Goodrich Co.
Link-Belt Co.
Raybestos-Manhattan, Inc.
Reeves Pulley Co.
United States Rubber Co.
Worthington Corp.

Drives — Chain
Chain Belt Co.
Diamond Chain Co., Inc.
Link-Belt Co.

Drives — Fluid
American Blower Div.

Drives — Geared
Allis-Chalmers Mfg. Co.
American Flexible Couplings
DeLaval Steam Turbine Co.
Link-Belt Co.
Lufkin Foundry & Machine Co.
Johnson Gear & Mfg. Co., Ltd.
Philadelphia Gear Works, Inc.
Western Gear Corp.
Worthington Corp.

Drives — Variable Speed
Allis-Chalmers Mfg. Co.
Chain Belt Co.
Electric Machinery Mfg. Co.
✔ General Electric Co.
Link-Belt Co.
Philadelphia Gear Works, Inc.
Reeves Pulley Co.
✔ Ridge Tool Co.
Sterling Electric Motors, Inc.
Westinghouse Electric Corp.
Worthington Corp.

DUAL FUEL ENGINES

Murphy Diesel Co.

GAS ENGINES

Allis-Chalmers Manufacturing
J. I. Case Co.
✔ Caterpillar Tractor Co.
✔ Cooper-Bessemer Corp.
✔ Ingersoll-Rand Co.
Jones & Laughlin Supply Div.

✔ Advertisement in this issue, index is on page A-6.

LeRoi Div., Westinghouse Air Brake Co.
Lufkin Foundry & Machine Co.
Nordberg Manufacturing Co.
Oil Well Supply Div.
Worthington Corp.

GAS TURBINES
Carrier Corp.
✔ Clark Bros.
✔ General Electric Co.
Westinghouse Electric Co.

GASOLINE ENGINES
Allis-Chalmers Manufacturing Co.
J. I. Case Co.
✔ Caterpillar Tractor Co.
Jones & Laughlin Supply Div.
LeRoi Div., Westinghouse Air Brake Co.
United States Steel Corp.
✔ Wisconsin Motor Corp.
Worthington Corp.

GOVERNORS
✔ General Electric Co.

STEAM ENGINES
Erie City Iron Works
✔ Ingersoll-Rand Co.
Worthington Corp.

STEAM TURBINES
Carrier Corp.
Dean Hill Pump Co.
DeLaval Steam Turbine Co.
Elliott Co.
✔ General Electric Co.
Pyle-National Co.
Westinghouse Electric Corp.
Worthington Corp.

Pipe and Tubing

FLEXIBLE HOSE

Fittings
Aeroquip Corp.
Central Scientific Co.
B. F. Goodrich Co.
Lincoln Engineering Co.
✔ O T M Corp.
✔ Parker-Hannifin Corp.
✔ Scaville Manufacturing Co.
Titeflex, Inc.
United States Rubber Co.

Metal
Aeroquip Corp.
American Metal Hose Div., Amer. Brass Co.
Atlantic Metal Hose Co., Inc.
B. F. Goodrich Co.
Rome Cable Corp.
Titeflex, Inc.

Rubber
Aeroquip Corp.
B. F. Goodrich Co.
Happy Co.
Lincoln Engineering Co.
Quaker Rubber Div. H. K. Porter Co.
Raybestos-Manhattan, Inc.
United States Rubber Co.

PIPE

Aluminum
Aluminum Company of America
Harvey Aluminum
Kaiser Aluminum & Chemical Sales, Inc.
A. B. Murray Co., Inc.
United States Steel Corp.
Victaulic Company of America

Asbestos
Johns-Manville Corp.

Brass
Bridgeport Brass Co.

Cast Iron Pipe
United States Pipe & Foundry Co.

Cement Pipe
Carter-Waters Corp.
Johns-Manville Corp.

Ceramic Pipe
United States Stoneware Co.

Copper and Copper Alloy
Bridgeport Brass Co.
Chase Brass & Copper Co., Inc.
Lewis-Mathes Co.
Phelps Dodge Copper Prod. Corp.

Glass Pipe
Corning Glass Works
W. H. Curtin & Co.

Plastic
Amercoat Corp.
Cooper Alloy Corp.
Corning Glass Works
✔ Kralay Plastic Pipe Co.
Maintenance Engineering Corp.
A. B. Murray Co., Inc.
✔ National Tank Co.
National Tube Div., U. S. Steel Corp.
Republic Steel Corp.
Southwestern Plastic Pipe Co.
United States Rubber Co.

Stainless Steels
Allegheny Ludlum Steel Corp.
✔ Babcock & Wilcox Co.
Carpenter Steel Co.
Crucible Steel Co. of America
A. B. Murray Co., Inc.
Pacific Tube Co.
Republic Steel Corp.
Steel & Tube Div., Timken Roller Bearing Co.
United States Pipe & Foundry Co.
United States Steel Corp.
Youngstown Sheet & Tube Co.

Steel, Alloy
Armco Drainage & Metal Prod. Co.
✔ Babcox & Wilcox Co.
Baldwin-Lima-Hamilton Corp.
A. M. Byers Co.
Carpenter Steel Co.
Crucible Steel Co. of America
✔ L. B. Foster Co.
Fritz W. Glitsch & Sons, Inc.
Goslin-Birmingham Mfg. Co.
Harvey Aluminum Co.
✔ International Nickel Co., Inc.
Jones & Laughlin Steel Corp.
✔ Lone Star Steel Co.
Maintenance Engineering Corp.
A. B. Murray Co., Inc.
National Supply Co.
National Tube Div., U. S. Steel Corp.
Naylor Pipe Co.
Pacific Tube Co.
Pressed Steel Co.
Reading Tube Corp.
Republic Steel Corp.
Steel & Tube Div., Timken Roller Bearing Co.
United States Pipe & Foundry Co.
Victaulic Co. of America
Youngstown Sheet & Tube Co.

Wood Pipe
Arrow Tank Co., Inc.
Fluor Products Co.

PIPE AND TUBE ACCESSORIES

Inspection Equipment
I. S. Roberts

PIPE COILS AND BENDS
Grinnell Co., Inc.
Midwest Piping Co., Inc.
Pressed Steel Co.
Vulcan-Cincinnati, Inc.

PREFABRICATED PIPE
Alco Products, Inc.
Crane Co.
Fluor Products Co.
Frick Co.
Fritz W. Glitsch & Sons, Inc.
Goslin-Birmingham Mfg. Co.
Grinnell Co., Inc.
Kaighin & Hughes, Inc.
M. W. Kellogg Co.
Midwest Piping Co., Inc.
✔ National Tank Co.
Pressed Steel Co.
✔ Stearns-Roger Mfg. Co.
United States Steel Corp.
Vulcan-Cincinnati, Inc.

TUBING

Aluminum
Aluminum Co. of America
Crescent Insulated Wire & Cable Co.
Harvey Aluminum
Kaiser Aluminum & Chem. Sales, Inc.
A. B. Murray Co., Inc.
Okonite Co.
Wolverine Tube

Copper
American Brass Co.
Chase Brass & Copper Co., Inc.
Crescent Insulated Wire & Cable Co.
Lewin-Mathes Co.
Samuel Moore & Co.
✔ Mueller Co.
Okonite Co.
Phelps Dodge Copper Prod. Corp.
Reading Tube Corp.
Wolverine Tube

Galvanized
General Cable Corp.

Plastic
Corning Glass Works
Crescent Insulated Wire & Cable Co.
Samuel Moore & Co.
A. B. Murray Co., Inc.
Okonite Co.
Republic Steel Corp.
United States Rubber Co.
United States Steel Corp.
United States Stoneware Co.

Stainless Steel
Allegheny Ludlum Steel Corp.
American Brass Co.
Carpenter Steel Co.
Crucible Steel Co. of America
A. B. Murray Co., Inc.
Pacific Tube Co.
Republic Steel Corp.
Steel & Tube Div., Timken Roller Bearing Co.
Superior Tube Co.
United States Pipe & Foundry Co.
United States Steel Corp.
Youngstown Sheet & Tube Co.

Steel, Low Alloy
Carpenter Steel Co.
Copperweld Steel Co.
Crucible Steel Co. of America
Fritz W. Glitsch & Sons, Inc.
A. B. Murray Co., Inc.
National Tube Div., U. S. Steel Corp.
Pacific Tube Co.
Pressed Steel Co.
Reading Tube Corp.
Republic Steel Corp.
Steel & Tube Div., Timken Roller Bearing Co.
Superior Tube Co.
United States Pipe & Foundry Co.
Youngstown Sheet & Tube Co.

Pipe Fittings, Valves, Etc.

EXPANSION JOINTS
Aeroquip Corp.
Badger Manufacturing Co.
✔ Dresser Manufacturing Div.
Garlock Packing Co.
✔ O T M Corp.
United States Rubber Co.
United States Steel Corp.
Yarnall-Waring Co.
Yuba Consolidated Ind., Inc.
Zallea Bros.

FILTERS, CARTRIDGE
V. D. Anderson Co.
Warner Lewis Co.

FLANGES
Alco Products, Inc.
American Flange & Mfg. Co., Inc.
✔ Babcock & Wilcox Co.
✔ Clayton Mark & Co.
Daniel Orifice Fitting Co.
Frick Co.
Grinnell Co.
Jones & Laughlin Supply Div.
Jordan Corp.
Ladish Co.
✔ Lenape Hydraulic Press. & Forg. Co.
Mack Iron Works
Midwest Piping Co., Inc.
✔ National Tank Co.
Oil Well Supply Div., U. S. Steel Corp.
✔ O T M Corp.
Pipe Line Development Co.
Robinson Orifice Fitting Co.
✔ Tube Turns
✔ Henry Vogt Machine Co.
Worthington Corp.

FLEXIBLE HOSE FITTINGS
Aeroquip Corp.
Imperial Brass Mfg. Co.
✔ National Tank Co.
✔ O T M Corp.
United States Rubber Co.

GASKETS AND MECHANICAL PACKING
Armstrong Cork Co.
Chicago Gasket Co.
Chicago-Wilcox Manufacturing Co.
C. Lee Cook Co.
Crane Packing Co.

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Durametallic Corp.
Flexitallic Gasket Co.
Frick Co.
Garlock Packing Co.
Johns-Manville Corp.
Metallo Gasket Co.
Metal Textile Corp.
✔ O T M Corp.
Raybestos-Manhattan, Inc.
Universal Packing & Gasket Co.
United States Rubber Co.
United States Stoneware Co.

LP-GAS SYSTEMS
Delta Tank Manufacturing Co.

LOADING ARMS AND ASSEMBLIES
Chiksan Corp.
Jordan Corp.
Oil Equipment Mfg. Co., Inc.

PIPE FITTINGS

Compression Fittings
✔ Dresser Manufacturing Div.

Plastic Fittings
Cooper Alloy Corp.
A. B. Murray Co., Inc.
✔ National Tank Co.
Walworth Co.
United States Rubber Co.

Screwed Fittings
Aluminum Company of America
American Instrument Co.
Capitol Mfg. & Supply Co.
Cooper Alloy Corp.
Crane Co.
✔ Dresser Manufacturing Div.
Fairbanks Co.
Frick Co.
Grinnell Co.
Jones & Laughlin Supply Div.
Jordan Corp.
Ladish Co.
Mack Iron Works Co.
Maintenance Engineering Corp.
Midwest Piping Co., Inc.
✔ Mueller Co.
W .C. Norris, Mfr.
Oil Well Supply Div., U. S. Steel Corp.
✔ O T M Corp.
✔ Parker-Hannifin Corp.
H. K. Porter Co., Inc.
Horace T. Potts Co.
R P & C Valve Co.
✔ Henry Vogt Machine Co.
Walworth Co.
✔ Wheeling Machine Products Co.
W-K-M Div., ACF Industries, Inc.

Welding Fittings
Alco Products, Inc.
Aluminum Company of America
American Instrument Co.
✔ Babcock & Wilcox Co.
Capitol Mfg. & Supply Co.
Cooper Alloy Corp.
Crane Co.
✔ Dresser Manufacturing Div.
Frick Co.
Grinnell Co.
Jones & Laughlin Supply Div.
Ladish Co.
✔ Lenape Hydraulic Press & Forg. Co.
Mack Iron Works Co.
Maintenance Engineering Corp.
Midwest Piping Co., Inc.
W. C. Norris, Mfr.
Oil Well Supply Div. U. S. Steel Corp.
✔ O T M Corp.
✔ Parker-Hannifin Corp.
Pipe Line Development Co.
H. K. Porter Co., Inc.
Horace T. Potts Co.
✔ Tube Turns
✔ Henry Vogt Machine Co.
Walworth Co.
Welding Fittings Corp.
W-K-M Div., ACF Industries, Inc.

PREFABRICATED PIPE
See Pipe and Tubing Section

PULSATION DAMPENERS
Allis-Chalmers Manufacturing Co.
Burgess-Manning Co.
Fluor Products Co.
Grinnell Co.
United States Rubber Co.

REPAIR PATCHES
Atlas Industries, Inc.
✔ Dresser Manufacturing Div.
Pipe Line Development Co.

SEALING COMPOUNDS
Johns-Manville Corp.
W-K-M Div., ACF Industries, Inc.

SLIP JOINTS AND CLAMPS
✔ Dresser Manufacturing Div.
Oil Equipment Mfg., Inc.
M. B. Skinner Co.
Staytite Co.

STRAINERS — LINE
American Flexible Coupling Div.
V. D. Anderson Co.
Blackmer Pump Co.
Black, Sivalls & Bryson, Inc.
Buffalo Meter Co.
Cambridge Wire Cloth Co.
Condenser Service & Engrg. Co., Inc.
Crane Co.
Cuno Engineering Corp.
Dollinger Corp.
Dorr-Oliver, Inc.
Durion Co., Inc.
Eclipse Fuel & Engrg. Co.
Engineering Corp. of America
✔ General Electric Co.
Hoke, Inc.
Jordan Corp.
Leslie Co.
Lunkenheimer Co.
Mack Iron Works Co.
Narda Ultrasonics Corp.
Ogden Filter Co., Inc.
✔ Peerless Manufacturing Co.
Sarco Co., Inc.
Schutte & Koerting Co.
Selas Corp. of America
Shand & Jurs Co.
Trinity Equipment Corp.
Worthington Corp.
Yarnall-Waring Co.
Yuba Consolidated Industries, Inc.

SWING AND BALL JOINTS
Chiksan Co.
Lunkenheimer Co.
A. Y. McDonald Manufacturing Co.
Oil Equipment Mfg. Co., Inc.
✔ O T M Corp.
Sealol Corp.
Shand & Jurs Co.
Staytite Co.
Wheaton Brass Works
Yuba Consolidated Industries, Inc.

TRAPS

Air or Gas Traps
V. D. Anderson Co.
Clark Manufacturing Co.
✔ O T M Corp.
United States Steel Corp.

Steam Traps
V. D. Anderson Co.
Clark Manufacturing Co.
Crane Co.
Jas. P. Marsh Corp.
✔ O T M Corp.
Sarco Co., Inc.
Yarnall-Waring Co.

TUBING FITTINGS
Chase Brass & Copper Co., Inc.
Imperial Brass Manufacturing Co.
Lunkenheimer Co.
Samuel Moore & Co.
W. C. Norris, Mfr.
✔ O T M Corp.
✔ Parker-Hannifin Corp.

UNIONS
✔ Catawissa Valve & Fittings Co.
✔ Clayton Mark & Co.
Grinnell Co.
✔ Guiberson Corp.
Industrial Instrument Corp.
Jones & Laughlin Supply Div.
Jordan Corp.
Ladish Co.
Maintenance Engineering Corp.
✔ Mueller Co.
✔ O T M Corp.
Titeflex, Inc.
United States Steel Corp.
✔ Henry Vogt Machine Co.

VALVES

Angle Valves
Crane Co.
Chapman Valve Manufacturing Co.
Edward Valves, Inc.
Frick Co.
Hammel-Dahl Co.
Jordan Corp.
Ladish Co.
Lunkenheimer Co.
NRC Equipment Corp.
Ohio Injector Co.
✔ O T M Corp.
Walworth Co.

Automatic Shutoff Valves
Automatic Switch Co.
Black, Sivalls & Bryson, Inc.
Crane Co.
Fairbanks Co.
Foster Engineering Co.
Fulton Sylphon Div., Robertshaw-Fulton Controls Co.
Handley-Brown Heater Co.
Jordan Corp.
Keiley & Mueller, Inc.
L-K Pump Valve Co.
Lunkenheimer Co.
Oil Equipment Mfg. Co., Inc.
✔ O T M Corp.
Schutte & Koerting Co.
Vernon Tool Co., Ltd.

Ball Valves
W. H. Curtin & Co.
NRC Equipment Corp.
✔ O T M Corp.
United States Rubber Co.
W-K-M Div., ACF Industries, Inc.

Butterfly Valves
Allis Chalmers Manufacturing Co.
Crane Co.
✔ Fisher Governor Co.
Hagan Chemicals & Controls, Inc.
Hammel-Dahl Co.
Lunkenheimer Co.
✔ National Tank Co.
W. C. Norris, Mfr.
✔ O T M Corp.
✔ Wm. Powell Co.
Schutte & Koerting Co.
United States Steel Corp.

Ceramic Valves
United States Stoneware Co.

Check Valves
Advanced Prod. Div., ACF Ind., Inc.
Automatic Switch Co.
✔ Catawissa Valve & Fittings Co.
Chapman Valve Manufacturing Co.
Crane Co.
Daniel Orifice Fitting Co.
Edward Valves, Inc.
Fairbanks Co.
Foster Engineering Co.
Frick Co.
Jordan Corp.
Ladish Co.
Lunkenheimer Co.
A. Y. McDonald Manufacturing Co.
Maintenance Engineering Corp.
✔ Mueller Co.
Ohio Injector Co.
Oil Well Supply Div., U. S. Steel Corp.
✔ O T M Corp.
Pennsylvania Pump & Compressor Co.
✔ Wm. Powell Co.
Schutte & Koerting Co.
Sealol Corp.
Shand & Jurs Co.
Vernon Tool Co., Ltd.
Walworth Co.
Worthington Corp.

Control Valves
Aktomatic Valve Co., Inc.
Atlas Valve Co.
Automatic Switch Co.
Barksdale Valves
Blackmer Pump Co.
Black, Sivalls & Bryson, Inc.
Bristol Co.
Denison Eng. Div., Amer. Brake Shoe Co.
Farris Flexible Valve Corp.
✔ Fisher Governor Co.
Foster Engineering Co.
Foxboro Co.
General Controls Co.
Hammel-Dahl Co.
Hanna Engineering Works
Jordan Corp.
Keiley & Mueller, Inc.
Ledeen Manufacturing Co.
Leslie Co.
Lunkenheimer Co.
Maintenance Engineering Corp.
Manning, Maxwell & Moore, Inc.
Jas. P. Marsh Co.
✔ Mason-Neilan
✔ Mueller Co.
✔ National Tank Co.
Ohio Injector Co.
Okadee Co.
Republic Flow Meters Co.
Shand & Jurs Co.
Taylor Instrument Co.
Western Electric Instrument Corp.

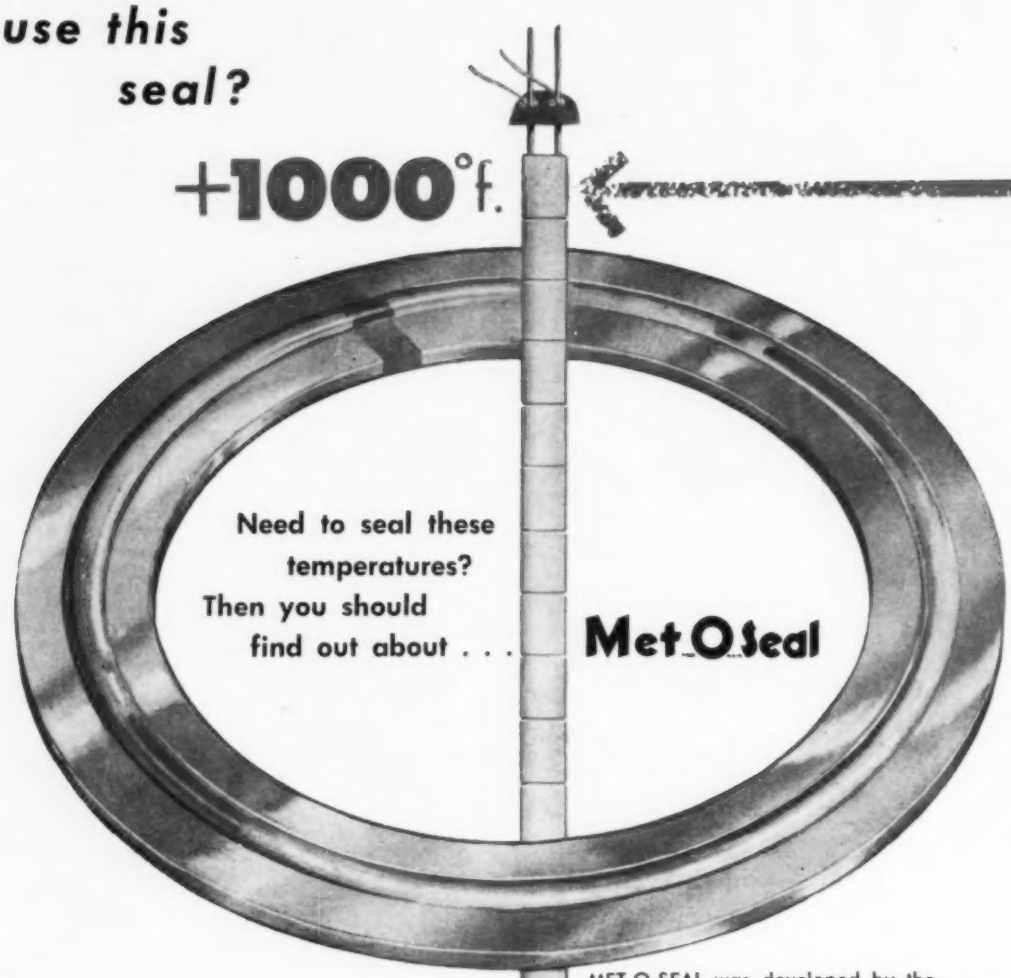
Diaphragm Valves
American Instrument Co.
Automatic Switch Co.
✔ Fisher Governor Co.
Grinnell Co., Inc.
Hammel-Dahl Co.
Hanna Engineering Works
Hills-McCanna Co.
Jordan Corp.
Keiley & Mueller, Inc.
Leslie Co.
Lunkenheimer Co.
Manning, Maxwell & Moore, Inc.
✔ National Tank Co.
Schutte & Koerting Co.

Float Valves
Black, Sivalls & Bryson, Inc.

✔ *Advertisement in this issue, index is on page A-6.*

can you use this seal?

+1000°f.



MET-O-SEAL was developed by the Franklin C. Wolfe Company to provide a practical answer to *no-leakage* sealing at extreme temperatures. Here are just some of the advantages obtainable:

- Lower machining costs
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- Can not blow out
- No loss of structural strength
- No leakage!

If you design in these temperature ranges why not find out about MET-O-SEAL, one of the proven members of the Gask-O-Seal Family?

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DU PONT *Petroleum Chemicals* NEWS

Number 86 in a Series of Bulletins for the Petroleum Industry — APRIL 1958

Knowing what really makes motorists buy HELPS DEALERS SELL

Still another in a series of Du Pont-sponsored surveys has been completed by National Analysts, Inc. The findings are now available in booklet form.

The survey report discloses what emotional reactions influence motorists to choose a service station, a brand of gasoline, a TBA product.

Psychological needs

The psychologists in conducting the study determined that there are four basic needs which can be fulfilled through purchase of service station products and services:

1. **Play**—use of car for recreation
2. **Aggression**—desire for speed and fast acceleration
3. **Conservance**—need to preserve car as an investment
4. **Infavoidance**—the desire of motorists to avoid the *appearance* of inferiority

Specific products

Gasoline sales, as you might suspect, are most influenced by the play and aggression needs. This finding indicates that gasoline advertising should appeal to motorists' desire for recreation and powerful car performance.

It was found that motor oil and grease satisfy the conservance need. The promotion of these products should be directed accordingly. Body polish, which might be thought to satisfy the conservance need, actually gratifies more often the need for infavoidance. So do white sidewall tires.

Anxiety influences

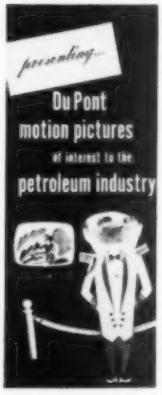
Two of the areas explored were anxieties about product quality and service.

Apparently women drivers are more concerned than men about tire quality and repair. This may be because a flat

Continued – over

Du Pont movies available for oil company showings

During recent years, the Du Pont Company has produced a wide variety of 16 mm sound motion pictures. Several of these are of direct interest to personnel in the oil industry.



Some of these films – such as *It Never Rains Oil* and *What Makes a Gasoline Good* – were made expressly for oil company use by our Petroleum Chemicals Division. There are a number of films also on farming, sports, safety, public relations and various industrial subjects. These films make excellent pro-

Continued – over

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT *Petroleum Chemicals* NEWS

CONTINUED

New Survey

tire is a greater inconvenience to women.

Women appear to have also a more generalized anxiety over automotive products they buy. This is possibly due to their having, in general, less mechanical knowledge than men.

Perceptions of service stations

Motivational needs lead to motorists' perception of different service stations as places to do business. Perception is influenced also by the opinions of others, including families, and by advertising and promotion of the dealer or the company he represents.

A summary of the findings of the survey are available in book form for easy reference.

CONTINUED

Du Pont Movies

gram material for dealer meetings and showings to customer groups.

Prints are available to oil companies on a loan basis, without charge.

All these Du Pont films are described in a new booklet "Du Pont Motion Pictures of Interest to the Petroleum Industry." The booklet gives information also about requesting the films for your own use. Any of our representatives or sales offices will be glad to send you a copy.

See the
DU PONT SHOW OF THE MONTH
on CBS

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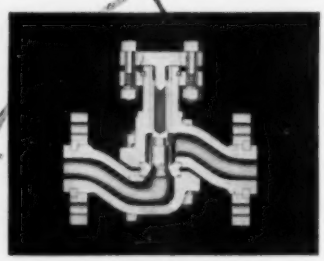
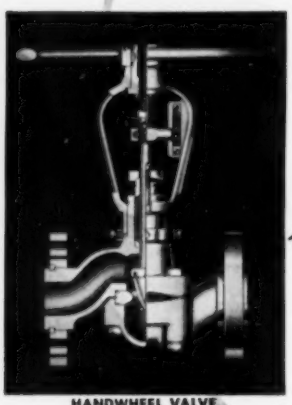
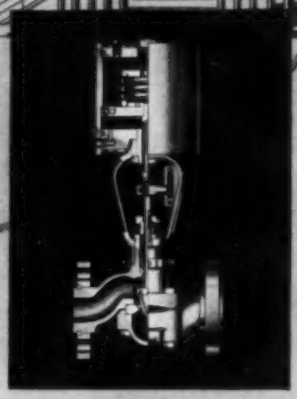


CHECK VALVE



HANDWHEEL VALVE

DOMOTOR VALVE



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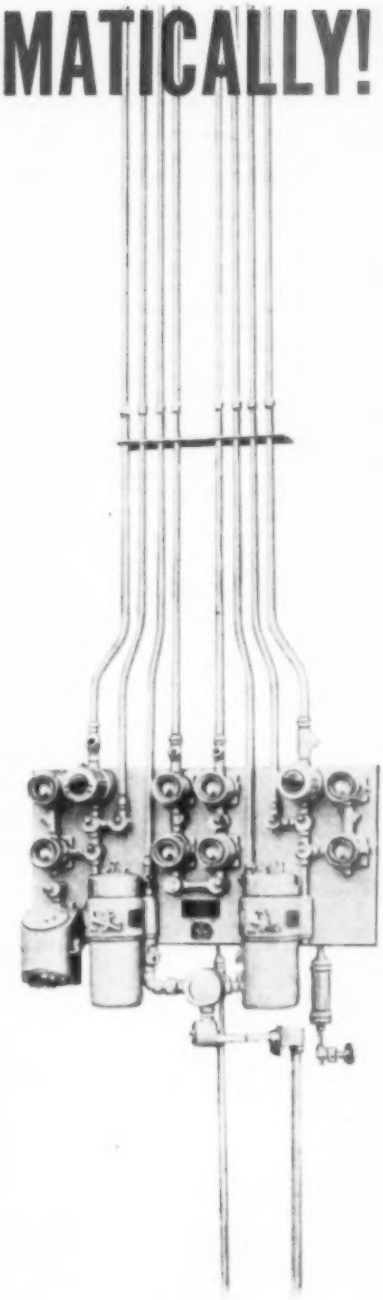

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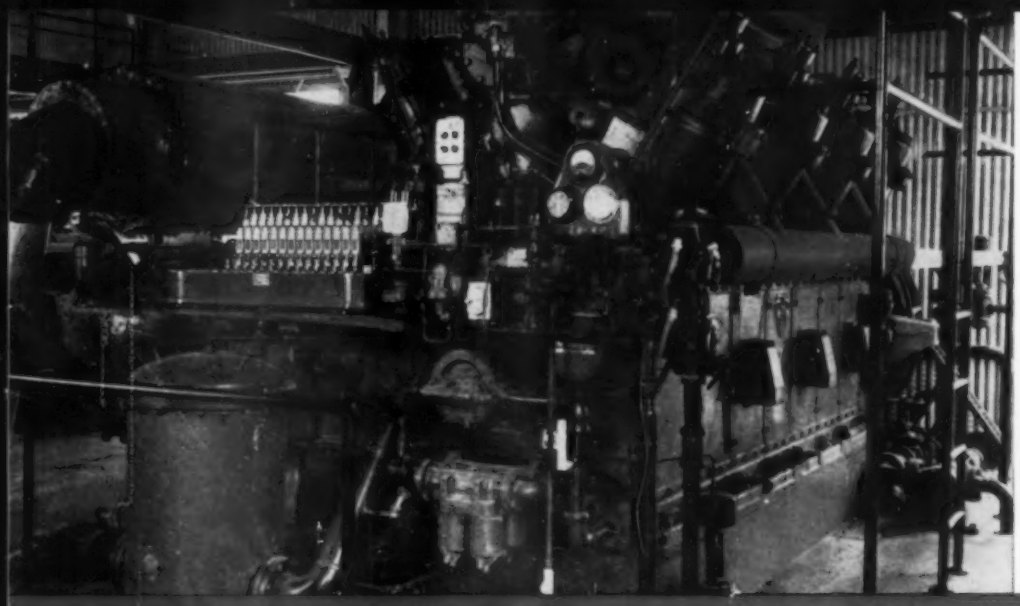
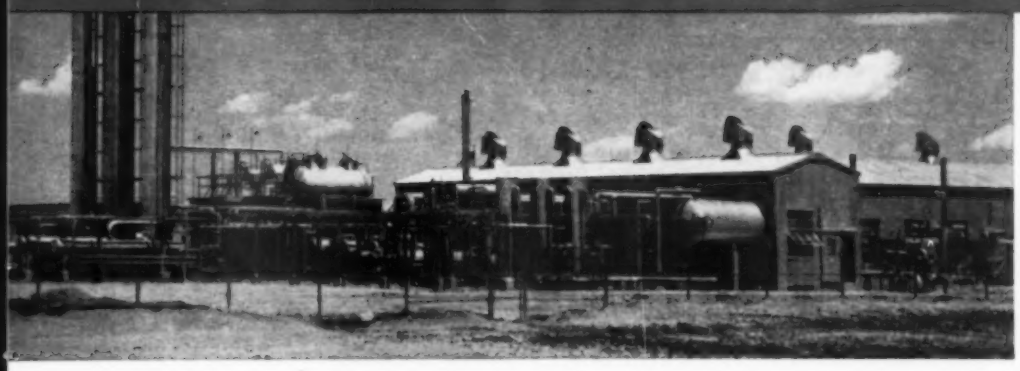


One of the 8-cylinder GMXA's compressing low pressure gas for the production of propane, butane and gasoline in the Little Beaver "dry" gasoline plant.

Another example of efficient power at lower cost



This modern plant in the Denver-Julesburg Basin contains eight Cooper-Bessemer 500 hp GMX-A's totaling 4,000 reliable compressor horsepower.

In the Denver-Julesburg Basin . . . multiple service . . . . multiple advantages with portable **COOPER-BESSEMERS**

• Offering unmatched economy in all phases of operation . . . Cooper-Bessemer GMXA compressors efficiently handle eight to ten million cubic feet of low pressure gas per day in the Little Beaver "dry" gasoline plant, Morgan County, Colorado.

Operated by Continental Oil, and owned by a number of companies, this plant in the Denver-Julesburg Basin is connected to a system of 169 wells. Six portable GMXA's, rated 500 hp at 400 rpm, handle three stage gas compression from 1 to 865 psig. Two additional Cooper-Bessemers are used for refrigeration and recompression service.

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COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
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✔ Catalytic Construction Co.
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Foster Wheeler Corp.
Holmes & Narver, Inc.
Jackson & Moreland, Inc.
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Kaiser Engineers
Kuljian Corp.
Lummus Co.
Macco Corp.
Ralph M. Parsons Co.
Pioneer Industrial Co.
J. F. Pritchard & Co.
Refinery Constr. Co. of Houston
Refinery Engineering Co.
Southwestern Engineering Co.
Stapp Engineering Corp.
✔ Stearns-Roger Mfg. Co.
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Construction Service Co.
Delta Engineering Corp.
Ehrhart & Associates, Inc.
Graver Construction Co.
✔ Hammond Iron Works
Kaiser Engineers
Kuljian Corp.
Macco Corp.
✔ National Tank Co.
Ralph M. Parsons Co.
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Refinery Engineering Co.
Southwestern Engineering Co.
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Chemical Construction Corp.
Construction Service Co.
Foster Wheeler Corp.
Graver Construction Co.
Holmes & Narver, Inc.
Kaighin & Hughes, Inc .
Kaiser Engineers
Kuljian Corp.
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Pioneer Industrial Co.
J. F. Pritchard & Co.
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Houdry Process Corp.
Socony Mobil Oil Co.

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Phillips Petroleum Co.
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Foster Wheeler Corp.
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Lummus Co.
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Coking, Fluid

Esso Reserach & Engineering Co.
Foster Wheeler Corp.

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✔ Tretolite Co.

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Shell Development Co.
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Fluor Corp., Ltd.
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Houdry Process Corp.
M. W. Kellogg Co.
Phillips Petroleum Co.
Socony Mobil Oil Co.
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M. W. Kellogg Co.

Thermal

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Houdry Process Corp.
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Birm 9 Ala, Box 5913, Geo S Edwards Co ... TR 1-0251
Houston 24 Tex, Box 19184, The Monday Co ... HO 5-0885
L A 22 Cal, 1238 S Atlantic Blvd, W Scott Turner ... AN 2-6935
New Britain Pa, A C Read ... DO -2215
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Phila 7 Pa, 1714 Phila Natl Bk Bldg, E R Averett ... RI 6-3420
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Youngstown 3 O, 25 E Boardman St ... RI 3-5175

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Roch 18 N Y, 3700 East Ave, N J Hammond ... LU 6-6496
South Bend 1 Ind, 805 J.M.S. Bldg, A D Hancock ... CE 2-3333
Spokane 1 Wash, 610 Fidelity Bldg, R E Burns ... RI 7-6124
Springfield 3 Mass, 146 Chestnut St, B C Mullen ... ST 8-4545
Syracuse 3 N Y, 731 James St, C A Yeaton ... GR 4-4407
Tampa 2 Fla, 820 First Natl Bk Bldg, S T Doutt ... 2-3718
Wichita 2 Kan, 1010 Central Bldg, R P Hotchkiss ... AM 5-4675
Wilm 1 Del, 1402 Del Trust Bldg, J M Piersol ... OL 6-4643
Worcester 8 Mass, 22 Pleasant St Rm 201, D S Mussey ... PL 7-8371
York Pa, 25 N Duke St, A R Gneiser ... 8-2044
Youngstown O, 537 Ohio Edison Bldg, G K Shoak ... RI 4-8671

Amercoat Corporation
South Gate, Cal, 4809 Firestone Blvd ... LO 4-2581
G E Seidel, Exec Vice Pres
D O Lachmund, VP-Sales
Evanston Ill, 921 Pitner Ave, H J Miller ... DA 8-0250
(Chi) ... FB 1-2940
Houston Tex, 6530 Supply Row, Jon Rodgers ... WA 3-2878
Jacksonville Fla, 2404 Dennis St, A B Smith Jr ... EL 5-2693
Kenilworth N J, 360 Carnegie Ave, K M McCaslin ... CH 5-9110
(NYC) ... DI 9-0114

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Det 32 Mich, J C Linsenmeyer, Pres
E W Petersen, VP-Mrktg

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Springfield 7 Mass, 3664 Main St, S E Miller, V Pres ... 6-8311
J H Flaskamper, V Pres Sales
Richard C Keane, Mfr Sales
E A Bleeck, Service Sales
Chi 3 Ill, 37 S Wabash Ave, R R Parker ... DE 2-5591
Cleve 7 Ohio, 14900 Detroit Ave, J R O'Donnell ... AC 1-4446
Detroit 35 Mich, 17330 W McNichols Rd, R S Jay ... BR 3-8600
L A 58 Cal, 2940 E Leonis Blvd, L E Freeman ... LU 9-6111
Newark 2 N J, 60 Park Place, H I Margerum ... MI 2-1760
Woodside 77 N Y, 34-21 56th St, J A Foss ... IL 8-6100

American Brass Company, American Metal Hose Div
Waterbury 20 Conn, 414 Meadow St, A B Freeman, V Pres ... PL 4-1121
W B Hammond, Sales Mgr
Atlanta 8 Ga, 712 W Peachtree St, NW, L C Pratt ... TR 5-9291
Cambridge 42 Mass, 238 Main St, R R Sampson ... UN 4-9711
Chi 39 Ill, 4501 W North Ave, E J Campion ... BE 5-1000
Cinn 2 Ohio, 101 W Fourth St, G N Rowland ... GA 1-9050
Cleve 11, Ohio, 2200 W 117th St, C M Kelsey ... CL 1-1105
Detroit 31 Mich, 174 S Clark Ave, J E Jessup ... TA 5-3500
Houston 2 Tex, 1114 Texas Ave Bldg, J J Klaserner ... CA 5-3267
N Y 16 NY, 99 Park Ave, W S Adams ... OX 7-1166
Phila 22 Pa, 111 W Norris St, E W Schoolfield ... NE 4-7700
St Louis 3 Mo, 916 Shell Bldg, J J Moran ... CH 1-1155
Syracuse 2 N Y, 800 State Tower Bldg, C E Anderson ... HA 2-1305
Paramount Cal, 149000 Garfield Ave, W G Cooley ... NE 6-0321

American Cable Div, American Chain and Cable Co Inc
Wilkes-Barre Pa, 271 S Pa Ave, C N Johns, Pres ... VA 2-8191
E H Todd, Sales Mgr
Atlanta Ga, 1055 W Marietta St NW, N G Griffith ... SY 4-8226
Chi 6 Ill, 400 W Madison St, G A Faerber ... CE 6-9324
Denver 16 Colo, 4555 E 46th Ave, P D Steele ... FR 7-8807
Houston 1 Tex, 630 McFarland St, R D McNutt ... WA 3-2661
N Y 17 NY, 230 Park Ave, W W Runkle ... MU 6-8800
Phila 22 Pa, 2nd and Diamond Sts, J J Rowley ... RE 9-7460
Pgh 5 Pa, 2250 Noblestown Rd, W T Kyle ... WA 2-2100
San Fran 7 Cal, 890 Tennessee St, G F Lehr ... MI 7-4640

American Chain Div, American Chain and Cable Co Inc
N Y 17 NY, 230 Park Ave, C N Johns, Pres ... MU 6-8800
W B Ilko, Sales Mgr
Atlanta Ga, 1055 W Marietta St NW, M C Bond ... SY 4-8226
Boston 27 Mass, 69 "A" St, W F Morrissey ... AN 8-8792
Chi 6 Ill, 400 W Madison St, F L Rowe ... CE 6-9324
Denver 16 Colo, 4555 E 46th St, P D Steele ... FR 7-8807
Detroit 2 Mich, 2401 E Seven Mile Rd, W M Cusack ... TW 1-8810
Houston 1 Tex, 630 McFarland St, C A Goldstrohm ... WA 3-2661
L A 58 Cal, 6800 E Acco St, A C DeHaven ... RA 3-9751
Phila 22 Pa, Second and Diamond Sts, W P Perkinson ... RE 9-7460
Pgh 5 Pa, 2250 Noblestown Rd, W M Cusack ... WA 2-2100
Portland 10 Ore, 2210 NW Roosevelt St, A C DeHaven ... CA 6-2409
San Fran 7 Cal, 890 Tennessee St, A C DeHaven ... MI 7-4640

American Cyanamid Company, Industrial Chemicals Division
N Y 20 NY, 30 Rockefeller Plaza, G W Russell ... CI 7-0100
J F Allen, Sales Mgr Refinery Chemicals Dept
Boston 15 Mass, 1055 Commonwealth Ave ... ST 2-6000
Charlotte 1 N C, 3333 Wilkinson Blvd ... EX 9-0441
Chi 11 Ill, 3505 N Kimball Ave, R G Keppler ... CO 7-6400
Cinn 15 O, 2350 Glendale Milford Rd ... PR 1-5400
Cleve 14 O, 711 Leader Bldg ... CH 1-1933
Detroit 21 Mich, 10115 W McNichols Rd ... DI 1-9142
Houston 6 Tex, 3400 Montrose Blvd, T O McDonald ... CA 2-7850
Kalamazoo 99 Mich, 2715 Miller Rd ... FI 5-0129
L A 22 Cal, 2300 S Eastern Ave ... RA 3-6411
Mobile 10 Ala, 161 St Michael St ... HE 8-4646
N Y 18 NY, 48 W 38th St, E G Koffman ... CI 7-0100
Oakland 12 Cal, 1440 Broadway ... HI 4-5622
Phila 8 Pa, 401 N Broad St ... LO 3-6422
Port 8 Ore, 3030 NW 29th Ave ... CA 2-9687
St Louis 10 Mo, 5025 Pattison Ave ... MO 4-5306
Seattle 9 Wash, 550 Mercer St ... AL-3778
Tulsa 10, Okla, 822 E 6th St, H S Wood ... CH 2-2030
Waterbury Conn, Waterbury Natl Bk Bldg ... PL 5-2262

American Flange and Manufacturing Company Incorporated
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Richard L Parish Jr, Sales Mgr
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Linden N J, 1100 Blancke St ... HU 6-8222
Niles O, 643 Henry St ... OL 2-5811

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Frank W Zurn, Sales Mgr Mech Power Trans Div
Albert A Baker, Sales Mgr Fluid Control Div
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Battle Creek Mich, 503 Post Bldg, Lyle K Sherman ... WO 3-2012
Birm 5 Ala, Box 3254 S Highland Sta, Clisby-Moore Inc ... AL 1-0113
Boston Mass (Wellesley) 473 Wash St, G T Collatz ... CE 7-0831
Buff 3 NY, 564 Ellicott Sq, Vincent J Brown ... CL-1122
Chi 4 Ill, 141 W Jackson Blvd, Ehret and Kinsey ... WA 2-0449
Cinn 8 O, Box 65 Station "O", Lathrop-Trotter Co ... TR 1-2288
Cleve 14 O, 624 Engineers Bldg, Elmer W Pfeil ... MA 1-0560
Dallas 6 Tex, 5526 Dyer St, Robt K Koelling ... EM 1-1411
Denver 16 Colo, 600 W 48th Ave, J M Warner ... AC 2-2685
Det 1 Mich, 2457 Woodward Ave, A J Blecki ... WO 1-1260
Det 2 Mich, 1144 W Balt Ave, Industrial Equip Co ... TR 5-0950
Indpls 20 Ind, 6349 N Guilford Ave, Harkins Eng Sales Co ... CL 1-0848
K C 12 Mo, 612 W 47th St, W C Carolan ... JE 1-5505
L A 22 Cal, 6511 Whittier Blvd, Mark-Costello Co ... RA 3-4696
Memphis 11 Tenn, Box 6403 E Sta, Hunley A Slaughter ... GL 2-4278
Milw 8 Wis, 3904 W Vliet St, Ehret & Kinsey ... DI 2-7844
Mpls 7 Minn, 3651 Cedar Ave, Geo C May ... PA 9-9347
N Y 6 NY, 140 Cedar Street ... DI 9-0567
Phila Pa, (Swarthmore Pa) Theatre Sq, Cryer and Wolfe ... KI 4-1540
Phoenix Ariz, Box 6104, Ken Smith ... AL 8-0901
Port 9 Ore, 1645 NW Hoyt St, Bearing Sales and Service Inc ... CA 3-6301
Rich 19 Va, 403 E Franklin St, C Arthur Weaver ... MI 3-1895
St Louis 10 Mo, 4030 Chouteau Ave, Geo F Heath ... JE 1-6167
Salt L City 1 Utah, 576 W 8th South St, Sales Eng Co Inc ... EL 5-1162
San Diego 6 Cal, 3022 Voltaire St, Mark-Costello Co ... BE 4-4377
San Fran 3 Cal, 157 13th St, F Somers Peterson ... MA 1-2255
Seattle 4 Wash, 2908 6th Ave S, Bearing Sales & Serv Inc ... MU-0331
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Baltimore 15 Md, 2802 Ridgewood Ave, Elmer Freemire ... MO 4-5626
Birmingham Ala, 3110 Clairmont Ave S, G S Lawrence ... FA 3-1543
Bismarck ND, 215 Airport Rd, C C Larsen ... CA 3-5721
Boston 25 Mass, 82 Crescent Ave, L M Munroe ... GE 6-3305
Buffalo 2 NY, 349 Franklin St, J B Magee ... MO-6090
Camp Hill Pa, 2120 Market St, J F Scouler ... CE 6-0742
Chi 6 Ill, 330 S Wells St, R O Nelson ... WA 2-1092
Cinn 37 Ohio, 1720 Section Rd, Scott Gallagher ... EL 1-3140
Cleve 20 Ohio, 3537 Lee Rd, H F Knauper ... LO 1-2930
Cleve 6 Ohio, 12417 Cedar Rd, W G Jewett ... YE 2-0547
Cohoes NY, Albany-Saratoga Rd ... CE 7-0305
Columbus 15 Ohio, 101 N High St ... CA 1-4403
Corpus Christi Tex, 525 Glazebrook St ... UL 2-8271
Dallas Tex, 4024 Swiss Ave, J R Dowdell ... TA 3-9901
Davenport Iowa, 736 Federal St, E J Delarue ... 3-6961
Denver 2 Colo, 2124 Broadway, W W Jay ... AM 6-0323
Detroit 2 Mich, 726 Lothrop, J F Wolff ... TR 3-3200
East Orange N J, 9 Ampere Parkway ... OR 6-1163
E St Louis Ill, 1021 N 18th St, Gordon Hyatt ... BR 1-4355
Emeryville Cal, 1372 Ocean Ave ... OL 2-2522
Ft Wayne Ind, 541 Kinnaird Ave ... HA -0419
Ft Worth Tex, 600 Bailey St ... ED 2-9364
Greensboro N C, Box 2311 ... BR 5-2306
Houston Tex, 714 Bostrop ... CA 4-9616
Indpls 2 Ind, 1531 N Pennsylvania St, R Jackson ... ME 4-3463
Jacksonville Fla, 115 Park St, G A Israel, Jr ... EL 6-5601
K C 8 Mo, 1727-33 Walnut St, G J Wagner ... GR 1-2024
Knoxville Tenn, 1832 McCalla Ave, John M Dooley ... 2-3655
L A 15 Cal, 1356 S Flower, Jack Dean ... RI 7-3610
Louisville 2 Ky, 660 S Fifth St, T D Hall ... JU 4-2556
Lowell Ind, Box 25 ... 9140
Lubbock Tex, 3608 Ave A ... SA 4-2388
Memphis Tenn, 2470 Poplar Ave, F E Conaway ... GL 8-4461
Miami 34 Fla, 581 SW 47th Ave ... 83-3885
N O 6 La, 232 Canal St, John Dugan ... TU 0481
N Y 7 NY, 50 Church St, A F Hinrichsen ... BE 3-0020
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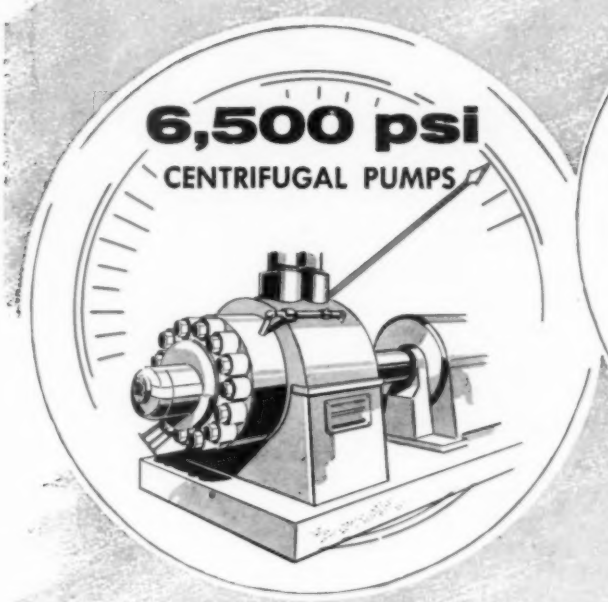

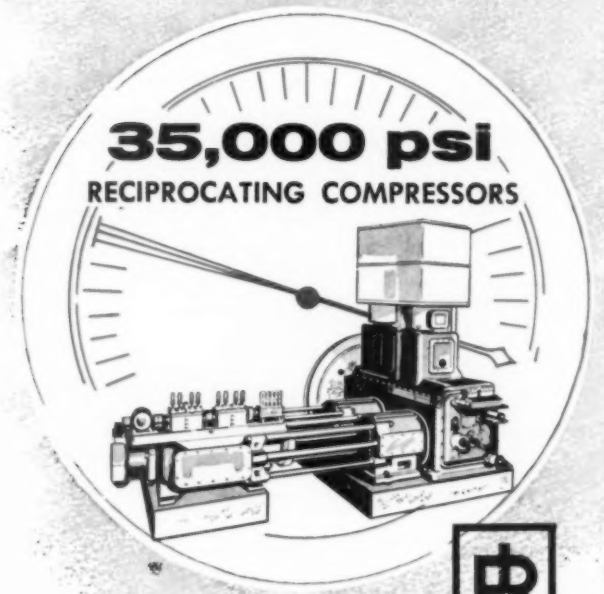

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Phoenix Ariz, 420 N 15th Ave ..... AL 8-2793
Pgh 5 Pa, Box 4453, Ken Tutein ..... WA 1-7900
Port 4 Ore, 317 SW Alder St ..... CA 2-9994
Richmond 9 Va, E Cary St, R H Shultz ..... MI 4-3021
St Paul 14 Minn, 704 Vandalia St, P W Abbott ..... MI 5-5847
Salt Lake City Utah, 204 Dooly Bldg, Clayton Williams ..... EM 4-6421
San Antonio Tex, 722 W Hildebrand ..... PE 5-6124
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Tampa Fla, 3624 Jetton Ave 8-3618
Terre Haute Ind, 721 W Prospect St CR-5931

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Chi III, 5822 W Lake St, Gordon L Taft ..... AU 7-9757
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Denver Colo, 529 E Ohio St, Charles R Jent ..... PE 3-5373
Houston Tex, 4101 San Jacinto, Edgar Sharp ..... JA 8-7954
L A Cal, 7579 Melrose Ave, J F Dauber ..... WE 8-2448
N Y NY, 30 Church St, Harvey G Seavy ..... CO 7-8374
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Pgh Pa, Box 267 Allison Park, G M Rolls ..... HU 6-5729
Rochester NY, 38 Scio St, W H Stewart ..... BA 5-0698

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N S Zaleiko, Asst Sales Mgr, Filtration Engineers
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N Y NY, 233 Broadway, R Lougel, Talhurst Div ..... RE 2-3822
N Y NY, 233 Broadway, L Jauhola, Filtration Div

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Battle Creek Mich, 60 Capital Ave NE, S G Rose, Pres ..... WO 8-6131
M R Bailey, Sales Mgr
N Y NY, 420 Lexington Ave, W J Auth ..... MU 4-6265

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Alhambra Cal, 1000 Meridian Ave ..... CU 3-2196
Atlanta Ga, 3084 Grandview Ave NE ..... CE 3-4527
Balt Md, 506 Maryland Trust Bldg ..... LE 9-5706
Birm Ala, 750 Brown-Marx Bldg ..... AL 1-8361
Boston Mass, 455 Commercial St ..... CA 7-8935
Chi III, 122 S Mich Ave ..... HA 7-2802
Denver Colo, 415 First Natl Bk Bldg ..... AL 5-9978
Fullerton Cal, 300 N Gilbert Ave ..... LA 5-8237
K C Mo, 900 Dwight Bldg ..... VI 2-5176
Mpls Minn, 3100 Humboldt Ave S RE-7396
N Y NY, 60 E 42nd St ..... MU 7-6980
Omaha Neb, 1109 W.O.W. Bldg WE-2002
Phila 16 Pa, 13500 Philmont Ave ..... OR 3-2100
Pgh Pa, 733 Wash Rd ..... LE 1-2822
San Fran Cal, 950 Tennessee St ..... AT 2-1700
Seattle Wash, 5511 White Bldg MU-3445
Wynnewood Pa, 50 E Wynnewood Rd ..... TR 8-2790

American Nickel Alloy Manufacturing Corporation
N Y 7 N Y, 30 Vesey St, R D Grunebaum, Pres ..... CO 7-6420
Albert Sulzbach, Sales Mgr

American Optical Company, Safety Products Division
Southbridge Mass, 82 Mechanic St, C H Galloway, Pres ..... PO 4-3211
John T Monahan, Safety Products Div
Representatives in Principal Cities

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L A 54 Calif, 3030 W Sixth St, Peter Calefax, Pres ..... DU 2-8231
W M Clines, Sales Mgr Western
E M Kolb, Sales Mgr Eastern (Heavy Chemicals)
A J Dirksen, Sales Mgr Eastern (Indus Chemicals)
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Chi 45 Ill, 3557 W Peterson Ave, John L Anderson ..... CO 7-0818
Columbus 15 Ohio, 12 N Third St, C A Lawton ..... CA 8-1041
N Y 16 NY, 99 Park Ave, E M Kolb, A J Dirksen ..... OX 7-0544
Port 1 Ore, 1320 SW Broadway, Paul F Staub ..... CA 6-2463
San Fran 4 Cal, 235 Montgomery St, Rod Taft ..... DO 2-1300
Shreve La, 1600 Fairfield Ave, William W Yound 5-4488

American Recording Chart Company
L A 23 Cal, 3113 E 11th St, James W Dunn Sr, Sales Mgr ..... AN 1-0321

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Freeport NY, Meadow Brk Natl Bk Bldg, L Bradie, Pres ..... FR 8-3390
Martin S Bradie, Sales Mgr
Casper Wyo, Box 832, J L Julian
Houston Tex, 1717 Chenevert St, Frank J Welu ..... FA 3-9176

Ames Iron Works Incorporated
Oswego NY, Albert Bradley, V Pres and General Mgr 920
D F Lytle, Sales Mgr
N Y 6 NY, 149 Broadway, J Scanlon ..... RE 2-5959

Ampco Metal Incorporated
Milwaukee Wis, 1745 S 38th St, J Donald Zaiser, Pres ..... MI 5-3750
J P Henry, Sales Mgr

Analytical Measurements Incorporated
Chatham NJ, 585 Main St, Frank G Paully, Pres ..... ME 5-2423
Pgh Pa, 4535 Veman Ave, Kurt J Lesker ..... TU 1-4666

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Tulsa Okla, 507 S Quaker, K W Anderson, Pres ..... GI 7-8411
Dallas Tex, 500 Santa Fe Bldg, Jack Simpson ..... RI 2-5594
Houston Tex, 1719 McKinney St, Brock Mott ..... CA 4-2768
Tulsa Okla, 507 S Quaker, Jack Simpson ..... LU 4-3270

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Michael J Toth, Sales Mgr, Purifier Div

Ansul Chemical Company
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L C McKesson, VP-Sales

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Chi 17 Ill, 8933 Stony Island Ave, A C Chevalier ..... RE 1-0650
Cleve 15 O, 1048 Hanna Bldg, C F Hooper ..... CH 1-1388
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Dallas Tex, 2927 Healey Dr, L M Dial Jr ..... BR 9-5122
Houston 23 Tex, Box 18445, V W Murry ..... CA 7-4159
K C Mo, 3303 Gillham Rd, C H Armstrong JE-1616
L A 22 Cal, 6470 Corvette St, J M Clark ..... RA 3-8931
Midland Tex, 1604 Neeley, E N Gideon ..... MU 2-4418
Milw 2 Wis, 715 N Van Buren St Rm 730, G B Vermilye ..... WO 4-9085
Mountainside N J, 1376 Rt 22, D N Francis ..... AD 2-4100
Oakland 6 Cal, 702 E 14th St, J G Holmes ..... TW 3-9361
Paoli Pa, 24 State Rd, A Dill PA-4550
Phila Pa, 1 Bala Ave (Bala Cynwyd) B L Felldin ..... MO 4-1382
Tulsa Okla, 1015 S Cinn, J C Morgan ..... CH 2-9041

Applied Science Corporation of Princeton
Princeton N J, Box 44, Thomas C Roberts, Pres ..... SW 9-1000
Jas K Delano, Exec VP
Erwin Donath, Eng VP
Robt O Wilson, Sales Mgr Ind Products Dept ..... SW 9-1000
Dallas Tex, 4918 Greenville Ave, A C Petrasek (Ind) ..... EM 1-1003
Clifton A Bischoff, Sales Mgr Electro-Mechanical Div ..... SW 9-1000
Van Nuys Cal, 15551 Cabrito Rd, D Lang, Elec-Mech ..... ST 2-7030
H John Heffernan, Sales Mgr Instrumentation Div ..... SW 9-1000
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Van Nuys Cal, 15551 Cabrito Rd, Carl Hoefener ..... ST 2-7030

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J Chambers, Sales Mgr Lighting
R Hood, Sales Mgr Pipe Fittings

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Houston 26 Tex, 2005 Quitman, F E Fuchs, Gen Mgr ..... CA 8-6696

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Lancaster Ohio, Box 431, M O Stepath, Pres ..... OL 3-5618
E J Lahmkuhl, Sales Mgr, Eastern
J Sperry, Sales Mgr, Midwest
D B Vaught, Sales Mgr, Southern
C A Ross, Sales Mgr, Western
Bremerton Wash, Box 4227, C A Ross ..... ES 7-3202

R S Aries and Associates
Stamford Conn, 77 South St, R S Aries, Pres ..... DA 5-2236

Armco Drainage and Metal Products Incorporated
Middletown Ohio, 703 Curtis St, S R Ives, Pres ..... GA 2-2711
R C Beam, Sales Mgr, Welded Pipe Sales Div
Tulsa Okla, 201 KOME Bldg, R E Walker ..... CH 2-7277

Armour and Company
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P L Sheppard, Reg Sales Mgr, Chemical Div
C D La Susa, Reg Sales Mgr, Chemical Div
L M Miller, Reg Sales Mgr, Chemical Div
Atlanta Ga, 3127 Maple Dr NE, L E Garrison ..... CE 7-2922
Charlotte NC, 210½ E Fifth St, B H Tannel ..... ED 2-2128
Cleve Ohio, 3704 Orange Ave, S L Pratt ..... EN 1-1160
Dallas Tex, 5738 Cent Expressway, C D La Susa ..... TA 3-2804
Detroit Mich, 18450 Livernois Ave, S J Hornak ..... DI 1-8768
Houston Tex, 1016 Commerce St, J P Badman ..... CA 2-1171
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Midland Tex, 139 Allen Bldg, R L Avinger ..... MU 3-1372
N Y NY, Lodi NJ (Toll Free), H E Newcambe ..... LO 4-5955
Phila Pa, 917 Noble St, W F Sindewald ..... PO 5-3001
Pgh Pa, 301 Anderson St, E S Apyar ..... CE 1-7350
St Louis Mo, 2030 Clark Ave, J F Richenaker ..... MA 1-3600
Syracuse NY, 305 S West St, D W Malec ..... GR 6-5391
Tulsa Okla, 1 N Detroit, L A Corona ..... CH 2-1800

Armstrong Cork Company
Lancaster Pa, W Liberty St, C J Backstrand, Pres ..... EX 7-5151
A E Pearce, Sales Mgr Insulation Div
W B Tucker, Sales Mgr Industrial Div

Richard M Armstrong Company
West Chester Pa, Box 188, Richard M. Armstrong, Pres ..... OW 6-1041
George Rittenhouse, Sales Mgr

Arrow Tank Company Incorporated
Buffalo 15 NY, 16 Barnett St, Arthur P. Pfeil, Pres TA-7200
Larry L Schwartz, Sales Mgr, Lumber

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Edward J Tracey, Sales Mgr

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Boston Mass, 43 Kendrick St (Wrentham) W F Cruwys ..... SO 6-7240
Chi 4 Ill, 220 S State St, V L Snobl ..... HA 7-7033
Dallas 1 Tex, 1211 Dragon St, M Zischkale ..... RI 1-4771
L A 22 Cal, 5346 Jillson St, C F Dempsey ..... AN 8-5109
N Y 6 N Y, 165 Broadway, J J Bresnahan ..... CO 7-2074

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Chi 11 Ill, 240 E Ontario St, H J Velten, Pres ..... WH 4-3700
W W Wheeler, Sales Mgr

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S Wayne Gailey, Sales Mgr
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Frank Marnld, Sales Mgr
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Balt 18 Md, 2317 Cecil Ave, H C Staley Jr ..... TU 9-1190
Birmingham 2 Ala, Box 2572, R L Conville ..... AL 2-4121
Boston 10 Mass, 115 High St, Sumner Levenson ..... HA 6-3900
Buff 4 NY, 9 Elk Mrkt Terminal, V G Mansell CL-5122
Charlotte N C, Box 10218, W R Davis ..... FR 6-5661
Dallas Tex, Box 5609, M E Robertson ..... LA 8-0311
Decatur Ga, Box 306, C W Mathis ..... DR 8-7350

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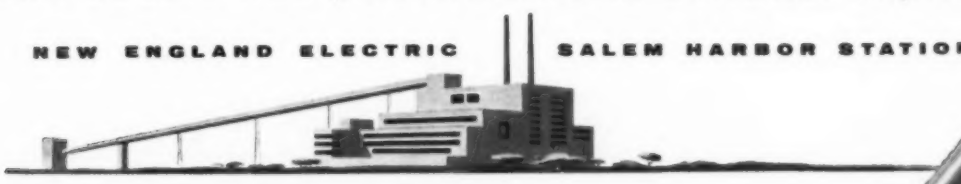

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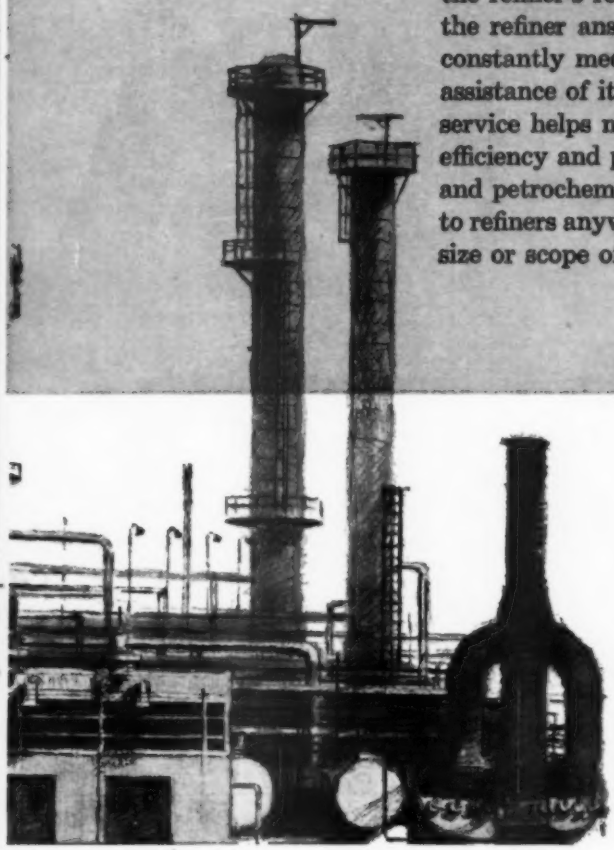

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Paul Bernard, Sales Mgr
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Orlando Fla, 29 E Ivanhoe Blvd, Donald C Jaeger ..... GA 5-5878

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Dallas 19 Tex, 6234 Peeler St, James B Newman ..... FL 2-0760
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Detroit Mich, 14222 Robson Ave, Gerald Flower ..... VE 8-5940
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Houston 11 Tex, 5701 Wash Ave, Jack Ribble ..... UN 1-6116
Indpls 5 Ind, 3465 College Ave, Donald Abbott ..... WA 4-1804
K C 12 Mo, 1214 W 47th St, W Walbraidge ..... JE 1-6550
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Mpls 9 Minn, 314 W 38th St, E J Holzer LO-0696
N Y 17 NY, 342 Madison Ave, J A Moore ..... MU 2-2420
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N Y 19 NY, 730 Fifth Avenue, J A Scheick ..... CI 7-5400
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Cinn O, 1717 Section Rd, Tom Jenkins ..... ME 1-1843
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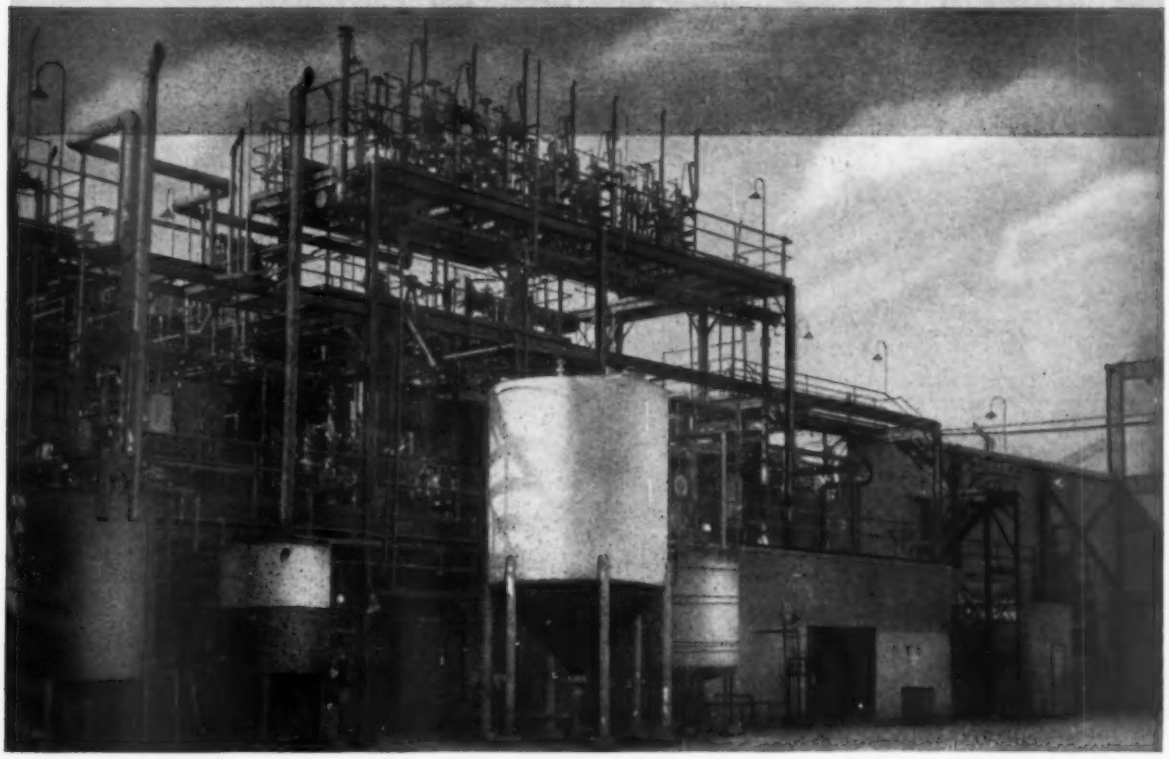

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Cinn 37 O, Box 2512, W C Shook ..... EL 1-0328
Cleve 2 O, 8905 Lake Ave, W C Juram ..... AT 1-6924
Columbus 15 O, 101 N High St, E K Hupprich ..... CA 1-6133
Dallas Tex, 528 Interurban Bldg, C H Parr ..... RI 2-4052
Dayton 6 O, 627 Salem Ave, R M Gabey OR-2442
Denver 16 Colo, 4555 E 46th Ave, R G Tower ..... DE 3-6228
Detroit 21, Mich, 10329 W McNichols Rd, J M Maitland ..... UN 4-4284
Hartford Conn, C C Mockridge EN-4050
Houston 6 Tex, 3617 W Alabama St, E A Merwin ..... MO 7-6509
Indpls 5 Ind, Box 55294 Uptown Sta, E J Wiedenheft ..... WA 4-4343
K C Mo, 300 Crawford Bldg, A R Willy ..... HA 1-7301
Knoxville Tenn, Box 202, J F Christopher 5-5992
L A 22, Cal, 6800 E Acco St, J W Peckham ..... RA 3-9751
Milw 2 Wis, 737 N Water St Rm 1327, H A Graf ..... BR 6-4393
Mpls Minn, Box 1101, J S Stenehjem AT-0714
Newark N J, 744 Broad St, R C Bechert ..... MI 2-6823
N O La WX-2881
N Y 19 NY, 250 West 57th St, H R Bristol ..... CI 5-4953
No Syracuse NY, Box 177, J F Peterson ..... GL 8-2320
Phila 7 Pa, Mrkt St Natl Bk Bldg, L E Mustard ..... RI 6-2386
Pgh 5 Pa, 2250 Noblestown Rd, L B Lumpkin ..... WA 2-2100
Port 10 Ore, 2210 NW Roosevelt Ave, L R Karoch ..... CA 6-2409
San Fran 7 Cal, 40 Berry St, J E Kearns ..... GA 1-5462
Seattle 1 Wash, 101 Jones Bldg, A H Webber EL-3361
St Louis 2 Mo, 434 Cotton Belt Bldg, W Messner ..... CH 1-7892
Tulsa 3 Okla, 607 Mayo Bldg, L D Allert ..... LU 4-2178
Wash DC ..... RE 7-0655
Waterbury 20 Conn, Bristol Rd, S M Hall ..... PL 6-4451
Wilmington Del, M217 Del Trust Bldg, W Patrylick ..... OL 4-1183

Brooks Rotameter Company
Lansdale Pa, 417 W Vine St, Douglas N Brooks, Pres ..... UL 5-5174
Seymour Blechman, VP-Sales
Representatives in Principal Cities

Brown Fintube Company
Elyria O, Huron St, J W Brown, Pres ..... FA 3-3291
J R Blakeslee, Sales Mgr Heat Exchanger Div
Amarillo Tex, Box 3151, Wayne L Griffiths ..... DR 3-6441
Bala-Cynwyd Pa, 29 Bala Ave, C B Thaw ..... MO 4-9450
Bay Village O, 27126 W Lake Rd, H F Maloney ..... TR 1-5223
Cinn 15 O, 1216 Ridge Cliff Rd, J A Gerlach ..... VA 1-5644
Dallas 18 Tex, 130 Casa Linda Plaza, Jack W Rush ..... DA 1-6471
Houston Tex, 2435 N Blvd Rm 104, R C Hagner ..... JA 3-1995
Memphis 6 Tenn, 1565 Harbor Ave, W M Ross ..... WH 2-3253
Pgh 22 Pa, 602 Empire Bldg, Harold G Jones ..... AT 1-8212
Port 12 Ore, 1908 NE Union, C C Sebbins ..... AT 7-1169
Seattle 99 Wash, 934 Elliott Ave W, E L Frost AL-5850
Tulsa Okla, 400 N Boulder, J E Hughes ..... LU 5-8211

Brown and Root Incorporated
Houston Tex, 4100 Clinton Dr, Herman Brown, Pres ..... FA 3-7121
W H Leslie, Gen Sales Mgr
G Hinman, Sales Mgr Oilfield Div
Ed Miner, Sales Mgr Pipeline Div
F W Bell, Sales Mgr Petro-Chemical Div
Arvada Colo, Box 388, Ted Adams ..... HA 4-4496
Corpus Christi Tex, Box 1996, J A Winner ..... UL 2-8285
Harvey La, Box 44, Marshall Watzon ..... FO 6-6425
Morgan City La, Box 392, J P Groves 2602
N Y NY, 1 Wall St, Domingo Moreno ..... WH 3-6235
Park Forest Ill, Rm 115 24 Plaza, H C Blard ..... SK 6-2310

Bucyrus-Erie Company
So Milwaukee Wis, L E MacDonald, Gen Sales Mgr ..... SO 2-0900
R C Adams, Sales Mgr Transit & Crawler Cranes
D B Smith, Sales Mgr Hydrocranes
Atlanta 3 Ga, 1508 Wm Oliver Bldg, W C Vines ..... JA 3-8446
Chi 3 Ill, 3100 Bankers Bldg, H J Vines ..... FR 2-5321
Dallas 1 Tex, 606 Tower Pet Bldg, E B Chambers ..... RI 1-4965
K C 12 Mo, 424 Nichols Rd Rm 201, H A Titus ..... VA 1-6281
L A 14 Cal, 308 Security Title Ins Bldg, H E Lowe ..... MI -9642
N Y 20 N Y, 30 Rockefeller Plaza, F Leslie Jones ..... CO 5-4830
Pgh 22 Pa, 2 Gateway Center Rm 958, B R Andres ..... AT 1-4815
Seattle 1 Wash, 4447 White-Henry-Stuart Bldg, B Haney ..... WA 4-9777
So San Fran Cal, 120 Freeway St, J H Sackett ..... PL 5-7436

Buffalo Meter Company
Buffalo 14 N Y, 2917 Main St, R S Bassett, Pres ..... PA -1011
H F Barrett, Sales Mgr
Representatives in Principal Cities

Buffalo Tank Corporation, Subsidiary of Bethlehem Steel Company
Dunellen N J, South Ave, Roy I Morrison, Pres ..... PL 6-0421
B W Grant, Sales Mgr
E W Brass, Sales Mgr Special Steel Platework
Albany 5 N Y, 177 Watervliet Ave, H G Anderson ..... AL 2-4464
Balt Md, Frankfurst Ave, J T Dowling ..... CU 7-1300
Bethlehem Pa, Box 1136, R H Goerlich ..... UN 7-4157
Buffalo N Y, Lake Ave, G R King ..... WO -1300
Canton 3 O, 921 Twelfth St NW, G O Wood ..... GL 6-0057
Charlotte N C, 1730 N Tryon St, E Beaver ..... FR 6-5631
Chi 4 Ill, 111 W Jackson Blvd, R R Johns ..... WA 2-7096
Det 35 Mich, 15800 W McNichols Rd, R R Martin ..... BR 3-5633
Dunellen N J, South Ave, B W Grant ..... PL 6-0421
Jacksonville Fla, 5349 Hwy Ave, W G Mahoney ..... EV 8-3585
L A Cal, 380 E Green St (Pasadena), H E Davis ..... BY 1-9676
Miami Fla, 12490 NE 7th Ave, R W Bennett ..... PL 8-0148
Phila Pa, Suburban Stn Bldg, A G Kamen ..... RI 6-4693
Port 2 Maine, Box 1611, R Gould ..... SP 2-0617
Rochester N Y, 33 University Ave, J H Crosier ..... BA 5-8230
Savannah Ga, 409 E 56th St, D W Ford ..... AD 3-9954
Syracuse N Y, 418 E Genesee St, G R Carpenter ..... GR 8-2109
Tampa Fla, Box 26 (Brandon) G E Kiley ..... BR 49-1853

Burgess-Manning Company, Industrial Silencer Div
Dallas 35 Tex, 9207 Sovereign Row, S G Paddock Exec VP ..... FL 7-1525
W A Carroll Jr, Sales Mgr Ind Silencer Div
Libertyville Ill, 749 E Park Ave, F C Duerr ..... LI 2-1800
N Y 36 N Y, 11 W 42nd St, R T Oliver Jr ..... BR 9-9418

Burgess-Manning Company, Penn Instruments Division
Phila 4 Pa, 4110 Haverford Ave, Dudley W Day, Vice Pres ..... EV 6-1001
R A McQuade, Sales Mgr Penn Instruments Div
Dallas Tex, 6234 Peeler St, C W Snyder ..... FL 2-0760
Houston Tex, 5701 Wash Ave, C W Snyder ..... UN 1-6116
Libertyville Ill, 749 E. Park Ave, James L. Floeck ..... LI 2-1800
N Y N Y, 11 W 42nd St, Scott Saunders ..... BR 9-9418
Tulsa Okla, 1432 E 6th St, Wm Kennedy ..... GI 7-0126

A M Byers Company
Pgh 22 Pa, Clark Bldg, B M Byers, Pres ..... AT 1-8110
R I Enzian, Sales Mgr
Atlanta 3 Ga, 716 Mortgage Guarantee Bldg, J A Cain ..... JA 5-4500
Boston 16 Mass, 200 Berkeley St (Rm 2410) J J Merrill ..... LI 2-0917
Chi 3 Ill, 135 S LaSalle St, G B Coffey ..... CE 6-0429
Houston 2 Tex, 1502 Mellie Esperson Bldg, N L Brown ..... CA 5-3526
N Y 20 N Y, 30 Rockefeller Plaza, V C Lawrence ..... CI 7-0040
Phila 2 Pa, 1120 Girard Trust Bldg, E L MacWhorter ..... LO 7-1711
Pgh 22 Pa, 1609 Clark Bldg, M C Morgan ..... AT 1-8110
St Louis 5 Mo, 8000 Bonhomme Ave, W B Simpson ..... PA 7-3809
San Fran 4 Cal, 1256 Russ Bldg, A D Sheere ..... YU 2-6760
Wash 4 D C, 934 Munsey Bldg, W J Kelly ..... EX 3-7440

Byron Jackson Pumps Inc, Division of Borg-Warner Corp
L A 54 Cal, 2300 E Vernon Ave, J P Adams VP-Gen Mgr ..... LU 7-6171
N D Jesse, Sales Mgr Engineered Pumps Div
W S Thomas, Sales Mgr Standard Pumps Div
Chi 5 Ill, 407 S Dearborn St, E R Raguse ..... HA 7-2375
Greenville S C, 314 E Coffee St, H Baldelli ..... GR 5-7820
L A (Htg Pk) Cal, 2157 Laura Ave, R A Winsryg ..... LU 7-6171
Houston 11 Tex, 6247 Navigation Blvd, E L Lindsey ..... WA 6-8321
N Y 36 N Y, 580 Fifth Ave, Alex Valchuk ..... PL 7-0400
San Fran 4 Cal, 369 Pine St, Don T Metz ..... SU 1-5812

C

California Research Corporation, Subsidiary of Standard Oil Company of California
San Fran 20 Cal, 200 Bush St, A L Lyman, Pres ..... SU 1-6867

Callery Chemical Company, Sub of Mine Safety Appliance Company
Pgh 37, 9600 Perry Hwy ..... FO 4-1130
R A Mulholland, Mgr Marketing Div
Dr E B Ayres, Sales Mgr Marketing Div

Cambridge Wire Cloth Company
Cambridge Md, Fred L Hooper, Exec Vice Pres ..... -1033
H E Pink, Sales Mgr Wire Cloth Div
J F Reid, Sales Mgr Woven Wire Belts Div
J C Applegarth, Sales Mgr Cripper Slings Div
Atlanta Ga, 76 Fourth St NW, Thomas M Creel ..... TR 2-1442
Balt 12 Md, 1515 Stonewood Rd, Joh B Hanson ..... HO 7-8500
Bellaire Tex, 5208 Willow Ave, Charles E Shuman ..... MO 4-2765
Chi III, 332 S Mich Ave, Howard E Claycombe ..... WA 2-3651
Det 8 Mich, 2567 W Grand Blvd, Richard C Carmean ..... TY 6-2155
Pgh Pa, 295 Beverly Rd, Harry W Byer ..... FI 1-1570
San Fran Cal, 420 Market St, Leslie F Moody ..... YU 6-4503
Tuckahoe 7 N Y, 429 White Plains Rd, John C Peters ..... WO 1-3300

Cameron Iron Works Incorporated
Houston 1 Tex, Katy and Silber Rds ..... UN 4-4411
Herbert Allen, VP-Gen Mgr
S R Davis, Sales Mgr Domestic Oil Tool Div
John H Grubb, Mgr International Div
Brookhaven Miss, Box 6, W R Holmes 2227
Carthage Tex, Box 534, W H Phillips 371
Casper Wyo, Box 708, M F Sherrod 3-8246
Chickasha Okla, Box 381, H D Thompson 678
Corpus Christi Tex, Box 2347, J B Ray ..... TU 3-1549
Farmington N M, Box 2058, J M Anderson ..... DA 5-6113
Ft Worth Tex, 805 W T Waggoner Bldg, C W Giraud ..... ED 6-2206
Glendive Mont, Box 168, R W McGhee ..... EM 5-4163
Lake Charles La, Box 165, I E Moses ..... HE 6-0803
Lg Beach Cal, Box 267, J H Page ..... HE 7-2036
McAllen Tex, Box 2055, T C Stedman ..... MU 6-3182
Midland Tex, Box 1298, T G Roscoe ..... MU 4-6667
New Iberia La, Box 121, F H Isaacks ..... EM 4-7664
N O La, 102 Shell Bldg, H E Brown MA-1609
N Y N Y, 7912 Empire State Bldg, D C Washburn ..... LO 5-2828
Odessa Tex, Box 19, W E Hodgens ..... FE 7-1516
Okla City Okla, Box 7213, Rodeon Hallmark ..... PE 2-5080
Patterson La, Box 337, H M Barr 2626

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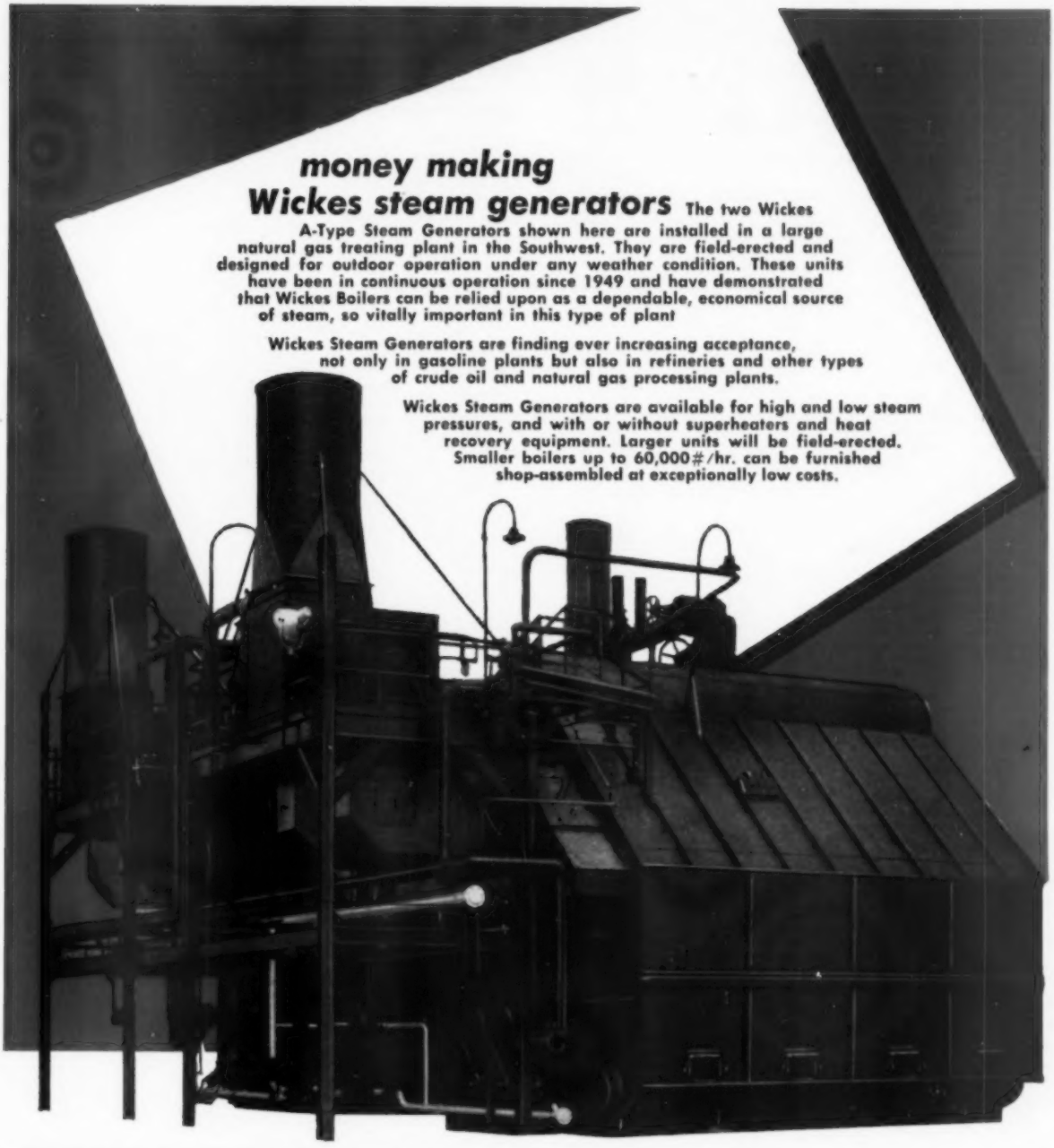

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166

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Ruston La, Box 124, J O Jackson ..... AL 5-3491
Tulsa Okla, 1810 Natl Bk of Tusla, R G Uhl ..... DI 3-3948
Victoria Tex, Box 365, Webb Carnes ..... HI 3-6611
Williston N D, Box 1301, J M O'Neill 3-3894

Candeo Construction Company, Oil and Gas Division
Houston 21 Tex, 7311 Almeda Rd, M I Leicher, Pres ..... JA 6-1421
Joe Cahill, Sales Mgr Oil and Gas Div

Capitol Manufacturing and Supply Company
Columbus 16 O, 153 W Fulton St, S M Melton, Pres ..... CA 8-6691
George M Levine, Sales Mgr
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Denver Colo, 1468 Galapago St, William Shannon ..... AM 6-2082
L A 15 Cal, 5738 W Washington, Max Zurier ..... WE 8-3767
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St Louis 17 Mo, 32 Hanley Ind Court, S L Lopata, Pres ..... MI 7-5795
Stanley L Lopata, Sales Mgr
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Houston 17 Tex, 6620 Dixie Dr, O A Melvin ..... OL 4-9514
N Y N Y, 299 Madison Ave, S Fiebach ..... MU 2-3235
Oakland 10 Cal, 3718 Grand Ave, T G Cullen ..... GL 2-3982
Tulsa 20 Okla, 1215 E 20th St, R Haynes ..... LU 2-8748
Wilmington 3 Del, Box 783, H C Johnson ..... PO 4-7479

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Reading Pa, 101 W Bern St ..... MU 6-7230
P L Coddington, Gen Mgr Alloy Tube Div
S R Staples, Sales Mgr Alloy Tube Div
Houston 17 Tex, 2502 Broad St, G A Davis ..... OL 4-6564
Melrose Pk Ill, 4501 James Pl, W A Baumstark ..... FI 3-8070
Pgh Pa, M-165 Greater Pgh Airport Bldg, H A Hauser ..... SP 1-4747
San Fran 11 Cal, 34 Cal St, R P Weyer ..... YU 6-4226
Union N J, 2165 Morris Ave, A W Harrington ..... MU 8-1540

Carrier Corporation
Syracuse 1 N Y, 300 S Geddes St, Charles V Fenn, VP ..... GR 6-9911
Frank Fives, Mgr Sales Div
Dallas 1 Tex, 10838 N Cent Expwy, Oscar Mehl ..... EM 8-3631
Houston 27 Tex, 2727 Weslayan St, Gordon V Bond ..... MO 7-9188
Okla City Okla, 5103 N Shartel St, Vic Cole ..... VI 2-1676

Carter-Waters Corporation
K C 8 Mo, 2440 Pennway, A R Waters, Pres ..... GR 1-2570
Robin E Walker, VP Sales

J I Case Company, Industrial Division
Racine Wis, 700 State Street ..... ME 4-6611
D A Milligan, Mgr Ind Div
Atlanta Ga, 4624 Peachtree Ind Dr, Burt E Moore ..... FL 7-3103
Balt Md, 1835 Washington Blvd, E M Graff ..... ED 6-4640
Columbus O, 1649 Olentangy River Rd, J E O'Connor ..... AX 4-4717
Dallas, Texas, 4708 Harry Hines Blvd, E C Metcalf ..... LA 6-1022
Indpls Ind, 1601 Madison Ave, Mel Saine ..... ME 2-9376
K C Mo, 2117 Broadway, Harold Feekays ..... GR 1-0650
Memphis, Tenn, La at S Pkwy, Robert Jones ..... WH 8-1586
Mpls Minn, 233 Park Ave S, George Mills ..... FE 3-2371
Oakland Calif, 1933 Peralta St, H L Hanson ..... TE 2-7331
Port Ore, 1709 SE Third Ave, W P Dutton ..... BE 2-9109
Racine Wis, 601 State St, Robt G McMaster ..... ME 4-1968
Syracuse N Y, 360 W Jefferson St, H R Carson ..... GR 5-9981

Catalin Corporation of America
N Y 16 N Y, 1 Park Ave, H Krehbiel, Pres ..... MU 3-2100
P Krental, Sales Mgr Chemicals Div
Calumet City Ill, 142nd St & Paxton Ave, H Pickles ..... WA 8-2969
Detroit Mich, 2970 W Grand Blvd, F Giordano ..... TR 3-6096
Hudson O, Box 695, A D Veale ..... OL 3-5482
L A Calif, 440 Seaton St, G Nebel ..... MA 6-1694
Louisville Ky, Box 1162, J Wolek AM-1818
Worcester Mass, 89 Prescott Ave, H Krehbiel Jr ..... SW 9-0847

Catalytic Construction Company
Phila 2 Pa, 1528 Walnut St, T Ellwood Webster, Pres ..... KI 5-7500
Henriques C Hamilton, Sales Office Mgr
Baton Rouge 2 La, 1719 Florida St, Richard P Klopp ..... DI 4-6816
Toledo O, 1810 Oakdale Ave, Raymond R Blickle ..... OX 3-4441
Tulsa Okla, 1755 S Quincy, Willis F Sims ..... RI 2-2737

Catalysts and Chemicals Incorporated
Louisville 10 Ky, 1230 S 12th St, Dr R E Reitmeier ..... ME 5-2691
Earl Englert, Sales Mgr
O R Matzner, Sales Eng

Catawissa Valve & Fitting Company
Catawissa Pa, 206 Main St, Fred R Long, Pres ..... EL 6-3011
H N Davis, Sales Mgr

Caterpillar Tractor Company
Peoria Ill, Abington & Perry Sts 6-3311
H H Howard, Vice Pres Engine Div
J H Bill, Mgr Engine Div
Representatives in Principal Cities

Cathodic Protection Service
Houston 6 Tex, 4601 Standor St, E P Doremus ..... JA 2-5171
Alvan Richey, Mgr Sales Div
John McIntosh, Mgr Protective Coatings Div
E P Doremus, Mgr Eng and Service Div
Corpus Christi Tex, Smith Prof Bldg, Hugh Wilbanks ..... TU 3-7264
N O 13 La, 1627 Felicity, Lee Spinks CA-7316
Odessa Tex, 5425 Andrews Hwy ..... EM 6-6731
Tulsa Okla, 4142 S Peoria, Jay James ..... RI 2-7393

Celanese Corporation of America, Chemical Division
N Y 16 N Y, 180 Madison Ave, Harold Blancke, Pres ..... MU 9-6000
Robt H Kampschulte, Sales Mgr Chemical Div
Charlotte N C, Box 1414, W L Milheim ..... FR 7-7411
Chi 11 Ill, 101 E Ontario St, E F Swanezy ..... MI 2-6166
Cleve 15 O, 1422 Euclid Ave, R A Schwab ..... CH 1-1290
Detroit 2 Mich, 2842 W Grand Blvd, J N Mamola ..... TR 1-6100
Framingham Mass, 24 Union Ave, M H Jamison ..... TR 3-7413
Houston 25 Tex, 1301 Prudential Bldg, E F Elbin ..... JA 3-5524
L A 5 Cal, 3460 Wilshire Blvd., T L Rogers ..... DU 1-3073
N Y 16 N Y, 180 Madison Ave, J W Morton ..... MU 9-6000
Palo Alto Calif, 535 Middlefield Rd, C H Snell ..... DA 6-6620
St Louis 8 Mo, 3615 Olive St, C S Aichler ..... JE 5-5022
Wilm 3 Del, 1035 F Phila Pike, H B Bartley Jr ..... SY 8-9543

Central Safety Equipment Company
Phila 35 Pa, 6600 Marsden St, Henry D Gordon, Pres ..... DE 3-4788
Michael F Gordon, Sales Mgr

Central Scientific Company
Chi 13 Ill, 1700 Irving Pk Rd, John T Gossett, Pres ..... WE 5-8600
J L Montgomery, Gen Sales Mgr
Birm 4 Ala, 3232 Eleventh Ave N, V E Goodwin ..... FA 4-2433
Cambridge 42 Boston Mass, 79 Amherst St, R H Parker ..... TW 6-3400
L A 22 Cal, 6446 Telegraph Rd, Gordon Baker ..... RA 3-6141
Mountainside N J, 237 Sheffield St, L M Boles ..... AD 3-2000
Santa Clara Calif, 1040 Martin Ave, V F Duensing ..... CH 8-1600

Century Electric Company
St Louis 3 Mo, 1806 Pine St, F H Pillsbury, Pres ..... CE 1-4920
R N Hill, VP Sales
G C Henderson, Genl Sales Mgr
Atlanta 5 Ga, T E McKamy ..... CE 3-5600
Balt 18 Md, J S Smith ..... BE 5-3529
Birm 2 Ala, J B Heil ..... FA 2-1181
Boston 10 Mass, W C Kohl ..... LI 2-3470
Buff 2 N Y, C C Croll MA-6616
Charlotte 3 N C, J P Clark ..... FR 6-4126
Chi 39 Ill, G H Hodgskiss ..... NA 2-4111
Cinn 2 O, P F Williams ..... PA 1-6625
Cleve 16 O, F R Hatfield ..... ED 1-3216
Dallas 2 Tex, Vernon Cox ..... RI 8-4477
Davenport Iowa, R E Emo 2-4436
Denver 2 Colo, M G Mueller ..... AC 2-3515
Det 2 Mich, K G Schmidt ..... TR 1-0760
Grd Rpds 2 Mich, W M Saneff ..... GL 4-5888
Hartford 3 Conn, J P Hoffberger ..... CH 6-5405
Houston 2 Tex, W B Hill ..... CA 8-2384
Indpls 4 Ind, R L Biller ..... ME 7-8233
Jacksonville 6 Fla, B E Tebo ..... EL 3-1162
K C 12 Mo, T E Witt ..... VA 1-4161
L A 21 Cal, J J Fryer TR-8526
Milw 3 Wis, W D Helm ..... BR 3-6620
Mpls 8 Minn, M W Tollefson ..... TA 7-2575
N O 8 La, Espy Reed CA-2703
N Y 7 N Y, G E Moe ..... CO 7-5510
Omaha 2 Neb, J S Jervis AT-1574
Phila 2 Pa, J M Hicks ..... GR 7 4407
Phoenix Ariz, J E Gohring ..... AL 4-8471
Pgh 22 Pa, J J Kochelek ..... AT 1-3129
Port 9 Ore, D R Vick ..... CA 8-4509
St. Louis 3 Mo, R A Jervis ..... CE 1-4920
Salt L City 14 Utah, Jack Lowder ..... IN 7-5489
San Fran 5 Cal, F L Hall ..... SU 1-2070
Seattle 4 Wash, T A Bender SE-8443
Spokane 2 Wash, B J Gill ..... HU 7-1502
Syracuse 2 N Y, L H Downing ..... HA 2-0473
Tulsa 3 Okla, H C Knappenberger ..... GI 7-8221

Chain Belt Company
Milw 11 Wis, 4701 W Greenfield Ave, L B McKnight, Pres ..... EV 4-3000
J W Snavely, Sales Mgr Conveyors & Elevators
G J Schuelke & R V Poisson, Sales Mgrs Chain Drives
J N Tufts, Sales Mgr R-ller Bearings
A C Lind, Sales Mgr Process Equip
R V Krikorian, Sales Mgr Centrifugal Pumps
Appleton Wis, 103 E College Ave, T C Jewell Jr ..... RE 4-4944
Atlanta, Ga, 1788 Ellsworth Ind Dr NW, D P Murrill ..... SY 4-1566
Balt 18 Md, 328 E 25th St, W W Byrne ..... HO 7-6257
Berkeley 10 Cal, 2940 Seventh St, R R Bolin ..... TH 3-6801
Birm 4 Ala, 113 N 9th St, R B Morrow 4-6225
Boston 10 Mass, 10 High St, J K Merwin ..... LI 2-8445
Buff 7 N Y, 1807 Elmwood Ave, M E Cusic DE-5004
Charlotte N C, 300 Clanton Rd, F R Trayler ..... FR 7-3670
Chi 6 Ill, 20 N Wacker Dr, G A Gunther ..... FR 2-4816
Cinn 37 O, 1720 Section Rd, C C Pingry ..... JE 1-8400
Cleve 13 O, 1510 Term Towr Bldg, J M Smallshaw ..... CH 1-4325
Dallas Tex, 8601 Sovereign Row, W W Klemme ..... FL 7-4001
Denver 16 Colo, 5460 Colo Blvd, J W LaFollette ..... AM 6-2292
Detroit 38 Mich, 10600 Puritan Ave, J C Toomey ..... DI 1-3222
E Orange N J, 19 N Harrison St, J B Roberts ..... OR 3-2120
Grand Rapids Mich, 638 Griggs St SE, L H Flaherty ..... CH 5-9266
Houston 25 Tex, 1100 E Holcombe Blvd, A B Calkins ..... JA 9-4548
Jacksonville 2 Fla, 1746 E Adams St, D B Hill ..... EL 3-5730
K C 11 Mo, 406 W 34th St, J F Abelt ..... JE 1-1505
L A 22 Cal, 7601 Telegraph Rd, W W Dawson Jr. ..... RA 3-4751
Milw 14 Wis, 4532 W Greenfield Ave, B E Sivyer Jr ..... EV 4-3000
Mpls 16 Minn, 6115 Excelsior Blvd, O E Lorenz ..... WE 9-2636
Moline Ill, 1630 Fifth Ave, B A Genzel ..... MO 4-2433
N Y N Y, 19 Rector Street, J S Moore ..... WH 3-6141
Phila 24 Pa, 4125 Whitaker Ave, HM Weil ..... GA 6-6150
Pgh 13 Pa, 3400 Forbes St, G F Sherratt ..... MU 1-6605
Port 10 Ore, 2310 NW 24th Ave, W E Church ..... CA 3-6121
St. Louis 5 Mo, 8000 Bonhomme, C R Studer ..... PA 7 6917
Salt Lake City 1 Utah, 375 S West Temple, P A Pelton ..... DA 2-4311
Seattle 4 Wash, 2425 Airport Way, R H Longwell MU-6750
Springfield 5 Mass, 32 Park St, E N Lutts ..... RE 6-2757
Stamford Conn, 26 Sixth St, H J Lavin ..... DA 4-5952

Chapman Valve Manufacturing Company
Indian Orchard Mass, 203 Hampshire St ..... LI 3-3331
C Goodwin Carter, Pres
Francis A Hunter, VP Sales
Atlanta 5 Ga, 415 E Paces Ferry Rd NE, W D Tautman ..... CE 7-0311
Boston 10 Mass, 75 Federal St Rm 912, E S Scullane ..... HU 2-8974
Chi 6 Ill, 400 W Madison St, J A Dunne ..... RA 6-5804
Cinn 15 O, Box 46 Lockland Branch, H T Porter ..... VA 1-4346
Cleve 14 O, 1740 E 12th St, V B Thomas ..... CH 1-4108
Denver 4 Colo, 500 Kalamath St, J B Ambler ..... TA 5-8885
Detroit 2 Mich, 801 New Center Bldg, Lee A Ross ..... TR 3-4848
L A 23 Cal, 2941 E 11th St, R D Wood ..... AN 1-2188
Houston 2 Tex, 812 Dowling St, W W Mitchell ..... CA 2-9806
N Y N Y, 233 Broadway, R C Mitchell ..... WO 4-5545
Pgh 22 Pa, 717 Liberty Ave, S P Nooney Jr ..... AT 1-1142
Phila 7 Pa, Liberty Trust Bldg, L I Kerr ..... LO 7-3748
San Fran 7 Cal, 564 Bryant St, B F Voss ..... SU 1-1637
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Salt Lake City 1 Utah, Kearns Bldg, L J Riter ..... EM 3-7933
Syracuse 2 N Y, 649 S Warren St, J C Tracy ..... HA 2-5341

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Waterbury 20 Conn, 236 Grand St, G P Bakken, Pres ..... PL 6-9444
W E Evans, Gen Sales Mgr
Atlanta 10 Ga, 695 Stewart Ave SW, A R Hooks ..... PL 5-5731
Balt 30 Md, 1315 Key Hwy, R W Sidbury ..... PL 2-2565
Boston 4 Mass, 411 "D" St, S A MacNeil ..... LI 2-0126
Charlotte 2 N C, 222 S Church St, T E Cox ..... ED 2-4152
Chi 39 Ill, 5401 W Grand Ave, W L Brown ..... TU 9-4000
Cinn 2 O, 222 Post Square, A H Heitz ..... PA 1-3326
Cleve 3 O, 4000 Chester Ave, A E Dillingham ..... HE 2-2300
Dallas 7 Tex, 119 Pittsburg St, A M Johnson ..... RI 7-4271
Denver 16 Colo, 5101 Colo Blvd, C J McWhinnie ..... DU 8-2441
Det 38 Mich, 14480 Woodrow Wilson Ave, E C Eickoff ..... TO 8-2939
Grd Rapids 2 Mich, 1537 Plainfield Ave, J Van Landeghem ..... RI 2-1048
Houston 1 Tex, 16 Drennan St, P C Barzier Jr ..... CA 2-7266
Indpls 25 Ind, 520 S New Jersey St, R Lea ..... ME 7-1543
K C 8 Mo, 1710 Wash St, P D Evans ..... VI 2-1710
L A 54 Cal, 6500 E Wash Blvd, R A Sternthall ..... RA 3-5351
Maspeth 78 N Y, 55-60 58th St, G C VanHeusden ..... TW 4-0500
Milw 3 Wis, 1741 W St Paul Ave, E J Finn ..... DI 2-7630
Mpls 3 Minn, 145 N Tenth St, F C Kaufmann ..... FE 6-5661
Newark 8 N J, 188 Badger Ave, L F Chol ..... BI 8-1700
N O 2 La, 751 Baronne St, J M Jolley ..... JA 2-9511
Phila 40 Pa, 20th & Venango Sts, W M Brown ..... BA 3-5800
Pgh 33 Pa, 1001 Brighton Rd, R H Stroth ..... CE 1-7900
Prov 1 R I, 66 Branch Ave, F M Burton ..... DE 1-2300
Roch 14 N Y, 45 Exchange St, F K Pulsifer ..... HA 6-3959
St. Louis 10 Mo, 4641 McRee Ave, L J Vogler ..... PR 6-3111
San Fran 7 Cal, 680 Second St, J D Wedlake ..... GA 1-7780
Seattle 4 Wash, 1957 First Ave, M A Pugh SE-1862
Waterbury 20 Conn, 40 E Farm St, C L Moseley ..... PL 6-9444

Chemical Construction Corporation, Sub of Electric Bond and Share Company (See Ebasco Services Inc)
N Y 36 N Y, 525 W 43rd St, James H Curtis, Pres ..... LO 4-9400
Samuel Streizoff, Gen Sales Mgr
Chi 4 Ill, 209 S LaSalle, R. H. Bradford ..... FI 6-3438
Dallas 1 Tex, 204 Southland Life Bldg, W A Buchanan ..... RI 7-3533
Port 4 Ore, 611 Equitable Bldg, W F Rooney ..... CA 6-2637
San Fran 4 Cal, 120 Montgomery St, H K Breckenbridge ..... YU 2-3463
Wash 6 D C, 1625 Eye St NW, W B Coudon ..... BE 7-3240

Chicago Gasket Company
Chi 22 Ill, 1271 W North Ave, Walter K Cardo, Pres ..... HU 6-3060
Robt H Martin, Sales Mgr

Chemical Process Company
Redwood City Cal, 1901 Spring St, A E Post, Pres ..... EM 9-0071
G F Stoneman, Sales Mgr

Chemical Research Associates Incorporated
Bernardsville N J, Essex Bldg, Dr J Rinse, Dir ..... BE 8-1553

Chemineer Incorporated
Dayton 2 O, 1044 E First St, R A Schaeffer, Pres ..... BA 2-8361
Chi 5 Ill, 407 S Dearborn St, R B Calhoun ..... WA 2-0733
Cinn 6 O, 920 E McMillan St, R A Mueller ..... PL 1-0583
Detroit 26 Mich, 1403 Kales Bldg, W S Mullen ..... WO 2-6021
Houston 2 Tex, Box 1035, N E Zachariah ..... MO 4-3504
N Y 18 N Y, 452 Fifth Ave, J G Papailias ..... LA 4-4051

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W L Drake, Sales Mgr
Representatives in Principal Cities

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Chi 4 Ill, 332 S Mich Ave, E E Michaels, Pres ..... HA 7-6708
F L Goldsby, Genl sales Mgr
Atlanta 3 Ga, 57 Forsyth St NW, M G Mitchell ..... JA 5-5561
Birmingham 1 Ala, Box 277, D A Miller ..... WO 1-1191
Boston 10 Mass, 201 Devonshire St, J E Revelle ..... HA 6-8441
Chi 4 Ill, 332 S Mich Ave, D A Leach ..... HA 7-6708
Cleve 15 O, 101 Prospect Ave W, R H Menefee ..... CH 1-1218
Detroit 26 Mich, 907 Lafayette Bldg, E D Barrett ..... WO 3-0035
Houston 2 Tex, C & I Life Bldg, S C Hamilton ..... CA 3-4425
N O 19 La, 312 Pan Am Life Bldg, J U Blanchard ..... .
N Y 6 N Y, 165 Brdwy, G E Borst ..... CO 7-2900
Phila 3 Pa, 1700 Walnut St, S L Luce ..... KI 6-4553
Pgh 19 Pa, 425 Sixth Ave, G S Trees ..... GR 1-5559
Salt Lake City 10 Utah, 550 W 17th So, J G Daniels ..... HU 4-8551
San Fran 4 Cal, 100 Bush St, L A Elsener ..... EX 2-8936
Seattle 1 Wash, 1318 Fourth Ave, R A Jackson SE-7487
So Pasadena Cal, 712 Fair Oaks Ave, D E Stephen ..... RY 1-2865
Tulsa 14 Okla, 6 Dowell Bldg, E P Shelton ..... RI 2-5511

✔ **Chicago Steel Tank Company, Div United States Industries Inc**
Chi 38 Ill, 6400 W 66th St, D D Cleghorn, Gen Mgr ..... PO 7-8900
R L Allen, Sales Mgr
N Y N Y, 51 E 42nd St, R Semler ..... MU 7-9298

Chicago-Wilcox Manufacturing Company
Chi 19 Ill, 701 S Avalon Ave, R B Anthony Jr, Pres ..... SA 1-1900

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Jack LaFave, Sales Mgr
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Olean N Y, Box 560, J N MacKendrick, Pres 2-2101

Clark Equipment Company
Battle Creek Mich, George Spatta, Pres ..... WO 2-6561
L A Depolis, Dir of Sales Ind Truck Div
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Auburn Me, 279 Center St ..... LE 4-5759
Aurora Ill, 52 S Lake St 2-4355
Balt 12 Md, 4410 York Rd ..... TU 9-2359
Birm 7 Ala, 905 Alabama Ave ..... ST 6-5214
Buff 25 N Y, 1775 Walden Ave FI-8600
Charleston W Va, 5324 McCorkle Ave SE ..... WA 5-5541
Charleston S C, 2019 Pittsburg St 6-1023
Chi 12 Ill, 625 N Kedzie Ave ..... SA 2-5036
Cinn 15 O, Lockland Rd & Shepherd Ln ..... PO 1-3165
Cleve 11 O, 3471 W 140th St ..... CL 1-2930
Columbia S C, 710 Crosshill Ave ..... SU 7-7772
Columbus 8 O, 1055 W Third Ave ..... AX 1-4622
Dallas Tex, 1410 S Akard St, F T Towne ..... RI 8-5055
Davenport Iowa, 518 W Fourth St 7-5286
Dayton 9 O, 2031 S Broadway ..... WA -4194
Denver 4 Colo, 2750 W 17th Ave, ... AL 5-1781
Detroit 2 Mich, 300 Milwaukee Ave E, ... TR 1-1600
Erie Pa, 1012 Liberty St, ... 5-3607
Eureka Cal, Ft of "S" St, ... HI 3-1681
Evansville 7 Ind, 900 Maxwell Ave ..... HA 5-6276
Ft Wayne 4 Ind, 3217 New US 30 E, ... EA -4662
Fresno 1 Cal, 1905 Mary St, ... AM 8-6256
Grd Rpds Mich, 3015 S Div, ... CH 1-4456
Greensboro N C, 418 E Mrkt St, ... BR 3-2856
Greenville S C, 85 Cleveland St, ... CE 9-4226
Hammond Ind, 7105 Kennedy Ave ..... CE 4-1113
Harrisburg Pa, 1500 Paxton St, ... CE 4-1113
Houston Tex, 5611 Clinton Dr, ... WA 8-3211
Indpls 5 Ind, 1121 E 46th St, ... CL 5-5468
Jacksonville Fla, 5270 W Beaver St, ... EV 8-8566
K C 8 Mo, 1941 Central St, ... VI 2-6966
Knoxville 17 Tenn, 312 S Springdale Ave, ... 4-2776
Latham N Y, Box 578 ..... (Colonie) ST 5 8548
Little Rock Ark, 110 W 9th St, ... FR 4-1252
L A 22 Cal, 5519 Jillson St ..... RA 3-6381
Lubbock Tex, 1610 Fourth St ..... PO 3-5386
Malden 48 Mass, 50 Commercial St ..... MA 2-1410
Massillon O, 644 N Erie St, ... TE 3-8544
Memphis Tenn, 185 E Butler, ... JA 5-5693
Miami 36 Fla, 1429 NW 7th Ave, ... FR 9-9979
Milw 16 Wis, 3040 W Capitol Dr ..... HI 4-9650
Mpls 7 Minn, 4141 Cedar Ave S, ... PA 2-9571
Misawaka Ind, 215 Lincolnway W, ... BL 9-3724
Mobile Ala, 401 Beauregard St ..... HE 3-3609
Newark N J, 357 Wilson Ave, ... MI 2-1920
New Haven 15 Conn, Amity Rd ..... FU 7-6616
N O 8 La, 7838 Earhart Blvd, ... UN 6-1876
N Y 19 N Y, 712 11th Ave, ... JU 2-3910
Norfolk Va, S Military Hwy ..... KI 5-5607
Oakland 21 Cal, 6601 San Leandro St, ... SW 8-9100
Omaha 2 Neb, 2056 Farnam St, ... AT -5573
Pawtucket R I, 503 Main St, ... PA 5-1560
Peoria 2 Ill, 1515 S Wash St, ... 6-8778
Phila 34 Pa, 2900 E Tioga St, ... GA 5-3500
Phoenix Ariz, 2308 S 11th Ave, ... AL 8-8951
Pgh 5 Pa, Pkwy W, ... WA 2-1234
Port 1, Ore, 5210 SW Corbett, ... CA 8-8603
Roanoke Va, 920 Fourth St SE, ... DI 3-4898
Roch 6 N Y, 1168 Lex Ave, ... GL 3-2122
Rockford Ill, 213 N Fourth St, ... 8-5721
Sacramento Cal, 3200 J St, ... GI 8-8248
St Louis Mo, 3338 S Jeff St, ... TO 5-2150
Salt Lake City Utah, 1361 S 2nd W, ... HU 4-7625
San Jose 12 Cal, 1441 Terminal Ave, ... CY 7-4566
Savannah Ga, 111 W Broad St, ... AD 2-5126
Seattle Wash, 1921 Minor Ave, ... MA -4256
Spokane Wash, E 4324 Trent Ave, ... KE 5-1776
Springfield 4 Mass, 116 Nursery St, ... ST 8-9624
Syracuse 6 N Y, Box 247 Eastwood Sta, ... HO 3-0249
Tampa 5 Fla, 3905 E Broadway, ... 4-1191
Toledo 9 O, 611 Daniels at Griffin, ... CH 3-2153
Tulsa 20 Okla, 403 S Peoria, ... CH 2-3091
Wash 24 D C, 500 Maine Ave SW, ... RE 7-3034
W Englewood N J, 1465 Palisades Ave, ...
Westfield N J, Box 421, ... WE 2-7060
Youngstown 2 O, 1554 Poland Ave, ... ST 8-4081

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Cleve 14 O, 1830 E 38th St, W S Goff, Pres ..... EX 1-1414
W S Burford, VP-Sales
Representatives in Principal Cities

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San Fran 4 Cal, 564 Market St, Kellogg Krebs, Pres ..... SU 1-6613

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T Bruce Cox, Mgr Union Sales Div
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Harold Holtz, Sales Mgr Boiler Div

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Helmuth W Schultze, Mgr Catalysts Devel
Chi 1 Ill, 230 N Mich Ave, J P McGuire ..... CE 6-2027
Dayton 2 O, 136 W 2nd St, H C Geittman Jr AD-6374
Denver 2 Colo, Midland Saving Bldg, T E Norman ..... KE 4-8371
Detroit 2 Mich, 624 Fisher Bldg, V A Crosby ..... TR 5-4180
L A 17 Cal, 650 S Grand Ave, J E Wilson TR-1028
Pgh 19 Pa, 1182 Union Trust Bldg, J F Robb ..... AT 1-6238

Cochrane Corporation
Phila 32 Pa, 3171 N 17th St, T E McBride, Pres ..... RA 5-2144
E J Bookout, VP & Genl Sales Mgr
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N O 13 La, 1040 St Charles Ave, F Fuller ... JA 2-3740
N Y 16 NY, 200 Mad Ave, R Beckman ... MU 9-4600
Phila 3 Pa, 1616 Walnut St, B W Webb ... PE 5-7020
Pgh 22 Pa, 1 Gateway Ctr, J Bass ... AT 1-1510
Roch 4 NY, 328 E Main St, R F Broas ... HA 6-4530
St Louis 15 Mo, 5319 Shreve Ave, W J Woodruff ... EV 1-1400
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Wash 6 DC, 1001 Conn NW, W H Billich ... DI 7-1418

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L A 21 Cal, 2424 Porter St, Claude Welcome, Pres ... TR-1051
L A Crispin, Gen Mgr
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J Robert Simpson, Sales Mgr
N Y 7 N Y, 30 Church St, Chas P Boyd ... WO 2-7553
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Pasadena Cal, 1025 E Green St, S H Zuck ... SY 5-4371
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Pgh 21 Pa, 708 Franklin Ave, C P Holderbaum ... FR 1-9955
San Diego Cal, 3266 Rosecrans St, S R Wyzenbeek ... AC 2-9630
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Houston 6 Tex, 3202 Mercer, T F Hudgins ... JA 9-4165
L A Cal, 1341 S Hope St, R D Sutherland ... RI 9-0561
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Phila Pa, Wayne Pa, M A Boulden ... MU 8-7429
Tulsa Okla, 4950 E 15th St, G B Gilliam ... WE 9-6600

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Glen Ellyn Ill, 360 Woodstock Ave, Jim Ziegler ... FR 2-4632
L A Cal, 5105 Telegraph Rd, Frank Card
Media Pa, Box 173, E B Powell
Pgh 8 Pa, 7110 Thomas Blvd, G E McGannon ... FR 1-7479

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S E Johnson, Sales Mgr

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Corning NY, P T Clark, Vice Pres ... 2-5011
C Rutledge, Sales Mgr
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N Y 19 NY, 718 Fifth Ave, I M Lawrence ... CI 6-8224
San Fran 3 Cal, 1355 Market St, C W Van Etten ... MA 1-9621

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Aberdeen S D, 324 Railroad Ave E., G W DeGroot ... 3135
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Grd Rapids 2 Mich, 56 Grandville Ave SW, C J Poznak ... GL 9-3344
Great Falls Mont, 2 Third St S, Frank E Hart ... GL 3-4934
Greenville S C, 223 W McBee Ave, G B Reed ... 2-3846
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Indols 6 Ind, 333 W Market St, W Stanley Hague ... ME 5-1521
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Jackson 5 Miss, 176 N Gallatin St, Eugene H Payne Jr ... 2-6428
Jacksonville 3 Fla, 1007 W Bay St, James U Mason ... EL 4-5621
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Oakland 7 Cal, 346 9th St, H I Gable ... GI 1-5577
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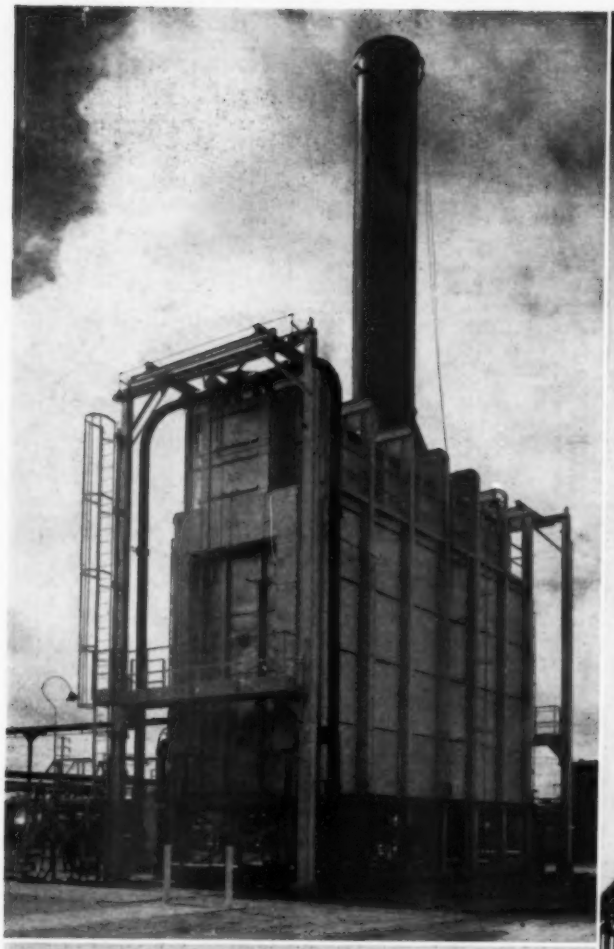

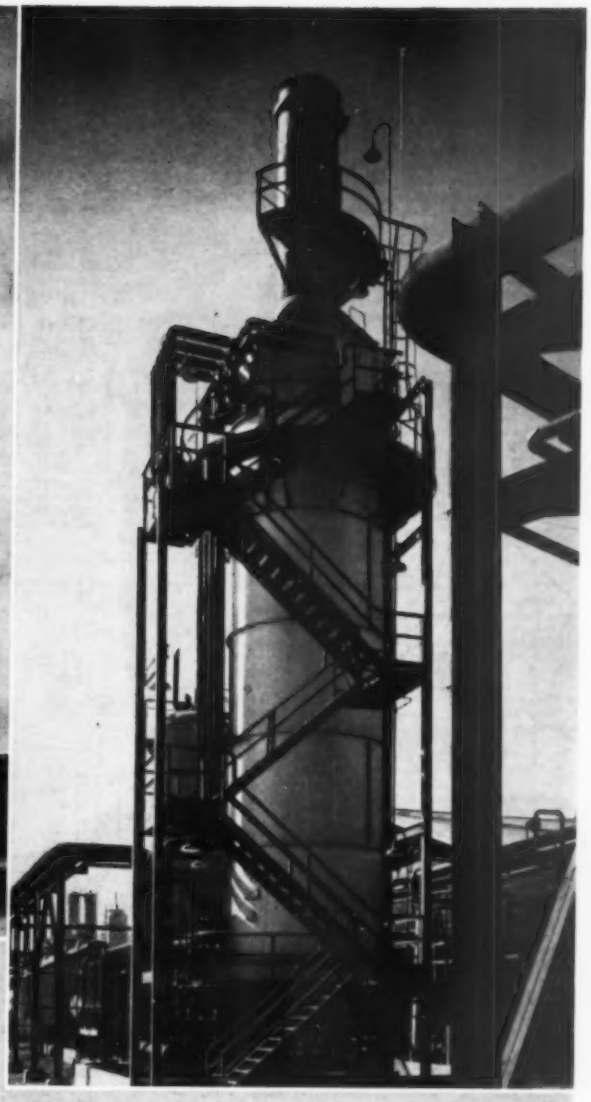

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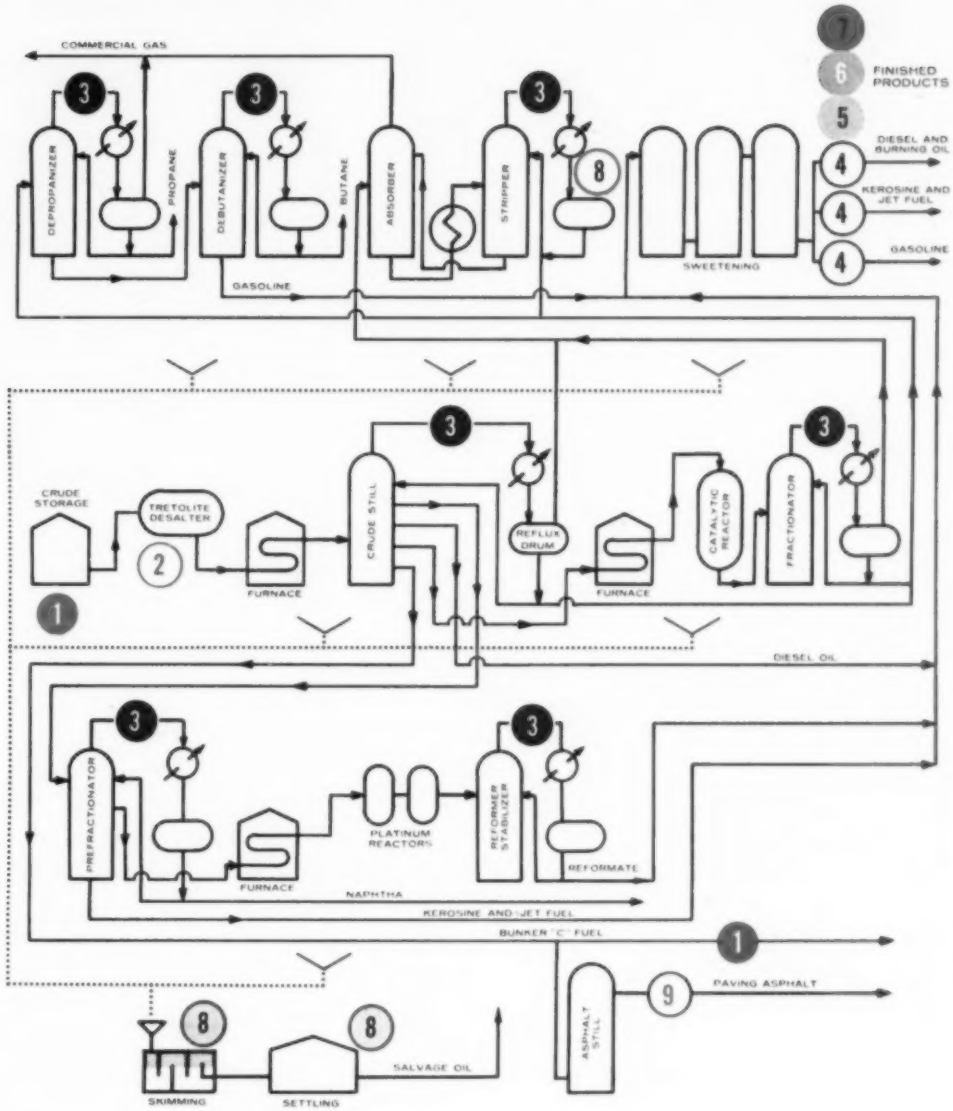

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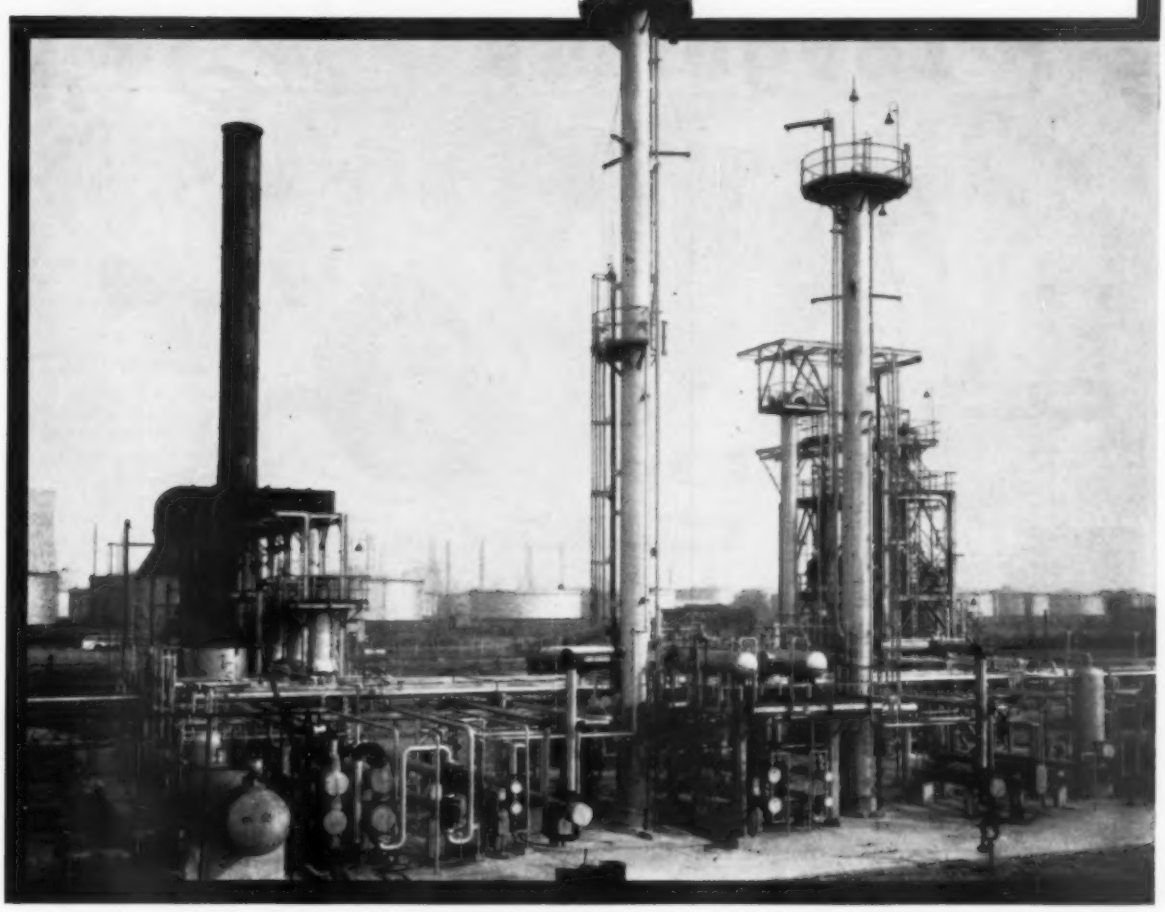

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Fig. 512—Small Bronze Gate Valve for 150 pounds W.S.P. Inside screw non-rising stem. Solid wedge disc. Can also be supplied with flanged ends.

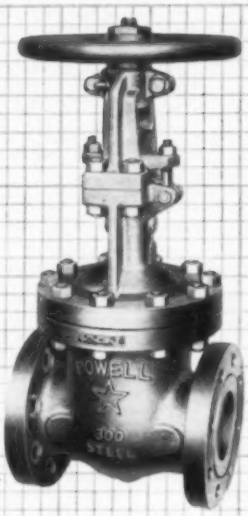

Fig. 3003—Steel Gate Valve for 300 pounds W.S.P. Outside screw rising stem and yoke. Solid wedge Disc, screwed-in seat rings. These valves also available for 150 pounds and higher pressures.

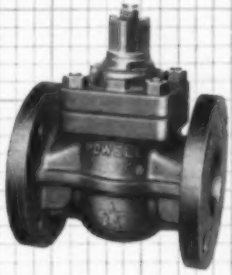

Fig. 2201—Semi-steel Lubricated Plug Valve for 175 pounds W.O.G. Single gland type. Sizes 1" to 4". Can be supplied with screwed ends. Other types and higher pressure valves are available.

Fig. 1793—Large Iron Body Bronze Mounted Gate Valve for 125 pounds W.S.P. Outside screw rising stem and yoke. Solid wedge disc.

Fig. 1561A—New Steel Swing Check Valve for 150 pounds W.S.P. When disc is in wide open position straight, unobstructed flow area through the valve is provided.

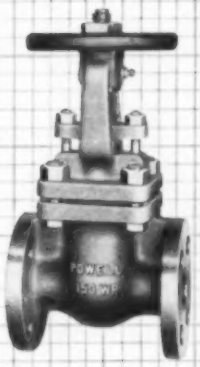

Fig. 2491—Small Stainless Steel Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke, solid wedge disc. Can be supplied with interchangeable double wedge discs. Available also with screwed ends.

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L A 58 Cal, 2930 E 44th St ... LO 5-6464
N Y 1 N Y, Empire State Bldg, 350 Fifth Ave ... LO 3-6400
Phila 3 Pa, 1616 Walnut St ... KI 6-4600
St Louis 1 Mo, 818 Olive St ... CE 1-8532
San Fran 4 Cal, 111 Sutter St ... EX 2-6230
Trade Sales Finishes Department
Atlanta 18 Ga, 1737 Ellsworth Ind Dr NW ... SY 4-9581
Boston 42 Mass, 35 Cambridge Pkwy ... UN 4-1442
Chi 30 Ill, 7250 North Cicero Ave, Lincolnwood
(Chicago Calls) IN 3-7250; (Others) OR 5-1010
Cleve 14 O, 3133 Chester Ave ... MA 1-8516
Dallas 21 Tex, 2607 Live Oak St ... VI-2517
Det 2 Mich, 5—238 General Motors Bldg ... TR 5-1990
K C 41 Mo, 6201 Manchester Trafficway ... EM 3-1390
Phila Pa, 308 E Lancaster Ave, Wynnewood ... MI 9-9747
San Fran 6 Cal, 612 Howard St ... EX 2-6230

Durametallic Corporation
Kalamazoo Mich, Factory St, Richard D Hall, Pres ... FI 3-2688
Roscoe R Smith, Sales Mgr
Baton Rouge La, 3862 Scenic Highway, Dale Fontaine ... 5-2413
Chi 40 Ill, 1737 E 75th St, Henry Smyth ... FA 4-4405
Ft Wayne 7 Ind, 636 Putnam St, J R Munn ... AN 8-7594
Houston 6 Tex, Box 6163 Fairview Sta, Allison Walker ... JA 2-7952
Huntington 1 W Va, 115 W Ninth Ave, R P vanBlaricom ... JA 5-0639
K C 12 Mo, 1214 W 47th St, H A Walbridge ... JE 1-6550
Lansing Mich, 1312 Pulaski St, R C Hruska ... IV 9-1169
L A 22 Cal, 4935 E Olympic Blvd, R L Rothwell ... AN 1-3165
Newark 2 NJ, 24 Commerce St, J L McQuillen ... MI 2-3444
Rochester 19 NY, 61 Rosalind St, Allen Gray ... GE 8-1926
St Louis 5 Mo, 34 N Brentwood Blvd, Chas Linderman ... PA 5-8759
San Fran 5 Cal, 51 Main St, Irvin Reed ... EX 2-6963
Seattle 4 Wash, Pier 50 ... SE-6926
Tulsa Okla, 606 Mayo Bldg, Richard Jones ... CH 2-8692
Youngstown O, 2574 S Meridian, D H Farwell ... RI 3-7075

Duriron Company Inc
Dayton O, 450 N Findley, R C Sckenck, Pres ... KE 2121
W D Staley, VP-Sales
W T Bryan, Mgr Anode Sales

Dust Suppression and Engineering Company
Lake Orion Mich, 120 Broadway, G C Ziliotto, Pres ... MY 2-6491

E

Eagle-Picher Company
Cinn 1 O, American Bldg, G L Christner, V Pres ... PA 1-7010
Walter D Myers Jr, Sales Mgr Industrial Insulation
Chi 2 Ill, 1 N LaSalle St ... CE 6-8277
Joplin Mo, C and Porter Sts ... MA 3-8000
K C 6 Mo, 950 Home Savings Bldg ... BA 1-1090
N Y 17 NY, 420 Lexington Ave ... MU 6-4930
Pgh 22 Pa, 1501 Oliver Bldg ... EX 1-0998

Eagle Signal Corporation
Moline Ill, 202 20th St, E R Freeberg, Pres ... MO 2-5571
E F Havey, Sales Mgr Industrial Sales
Atlanta Ga, 1823 Gordon Road SW, Thomas B Combs ... PL 8-5516
Balt Md, 124 Light St, H M Woods ... MU 5-4643
Berwyn Ill, 3136 S Clarence Ave, F G Hochriem ... ST 8-6485
Birm Ala, 1661 28th Ave S, A W McConnell ... TR 1-3501
Boston 15 Mass, 1018 Commonwealth Ave, W S Gibson ... AS 7-5074
Buffalo 2 NY, 170 Franklin St, D J Munhall ... MO-1212
Cleve 3 O, 4500 Euclid Ave, A R Virgien ... HE 1-7477
Dallas 1 Tex, Fidelity Union Bldg, Wm L Adair ... RI 8-1140
Dayton 2 O, 11 W Monument Ave, J J Thalheimer ... HE-9661
Denver 16 Colo, 4949 Colo Blvd, K C Peterson ... DE 3-5434
Des Moines 9 Ia, 308 E Sixth Ave, D E Bermann ... CH 3-7623
Detroit 27 Mich, 12818 Puritan Ave, Ralph D Ernest ... UN 1-7311
Hackensack NJ, 31 di Carolis Ct, C H Ribble ... DI 2-2602
Hartford 6 Conn, 141 Washington St, W A Hallock ... CH 7-6919
Houston 2 Tex, 372 M&M Bldg, Lynn T Elliott ... CA 4-9715
Jacksonville 2 Fla, 2727 Phyllis St, G G Easterday ... 4-6739
K C Mo, 5546 Troost Ave, Milton Duncan ... JA 3-2908
Lawton Okla, Box 1189, C B Anderson
L A 65 Cal, 3282 Fletcher Dr, Bernard S Hundley ... CL 5 7111
Miami 50 Fla, Box 11 Gratigny Br, C B Tornow Jr
N Y 16 NY, 13 E 40th St, A J Raible ... MU 9-0200
Oklahoma City Okla, Box 761, C B Anderson
Orlando Fla, 1015 W Central Ave, R E Ward ... GA 2-4295
Pgh 8 Pa, 6964 Thomas Blvd, J M Moore ... EM 1-8780
Port 11 Ore, 6019 NE Union Ave, Jim Sweiberg ... BU 5-5205
Richmond 22 Va, 2016 Second Ave, Frank E Cline ... 3-8529
St Louis 10 Mo, 4030 Chouteau Ave, Chas G Barger ... JE 3-0123
St Paul Minn, 1900 University Ave, R A Lundbeck ... MI 6-4523
Salt Lake City 7 Utah, 4777 S 13th E, S C Nabaum
San Fran 10 Cal, 1601 Cortland Ave, H E Campbell ... MI 8-1236
Seattle 1 Wash, 2136 Second Ave, Ray H Branam ... MA-7320
Tulsa Okla, 712 Oil Capital Bldg, C B Anderson
Upper Darby Pa, Box 146, Shelbourne Rd, W F Keegan ... FL 2-1125

Eastern Industries Incorporated
Hamden 14 Conn, 100 Skiff St, E D Stirlen, Pres ... CH 8-6321
H W Whitaker, Sales Mgr Pump Div
Paul Green, Sales Mgr Mixer Div

Eastman Chemical Products Inc, Sub of Eastman Kodak Co
Kingsport Tenn, William S Vaughn, Pres ... CI 6-2111
J E Magoffin, Sales Mgr Chemical Sales
Chi (Skokie) Ill, 4200 Dempster St, D B Campbell ... IR 8-2771
Cinn 2 O, 1813 Carew Tower, R R Shelly ... MA 1-6730
Cleve 20 O, 13212 Shaker Sq, R W Miller ... SK 1-2083
Denver 3 Colo, 851 Broadway ... AM 6-1886
Framingham Mass, 65 Concord St, S M Ryburn ... TR 3-3443
Houston Tex, Tex Natl Bank Bldg, J M Knight ... CA 7-5221
Kingsport Tenn, J E Magoffin ... CI 6-2111
L A 58 Cal, 4800 District Blvd ... LU 3-2103
N Y 16 NY, 260 Madison Ave, R H Cannon Jr ... OR 9-1820
Phoenix Ariz, 112 N Central ... AL 2-1287
Port 4 Ore, 520 SW Sixth St ... CA 2-1959
Salt Lake City Utah, 73 S Main St ... 3-3943
San Fran 4 Cal, 333 Montgomery St ... YU 6-4151
Seattle 4 Wash, 821 Second Ave ... MA-2380
Spokane Wash, 422 West Riverside ... MA-3638

Ebasco Services Incorporated, Subsidiary of Electric Bond and Share Company (See Chemical Construction Corporation)
N Y 6 NY, 2 Rector St, F C Gardner, Pres ... DI 4-4000
E P Noppel, VP-Sales
Chi 4 Ill, 209 S LaSalle, R H Bradford ... FI 6-3438
Dallas 1 Tex, 204 Southland Life Bldg, W A Buchanan ... RI 7-3533
Port 4 Ore, 611 Equitable Bldg, W F Rooney ... CA 6-2637
San Fran 4 Cal, 120 Mont St, H K Breckenridge ... YU 2-3463
Wash 6 DC, 1625 Eye St NW, W B Cosdon ... RE 7-3240

Eco Engineering Company
Newark 1 NJ, 12 N Y Ave ... MA 4-6565
James Eisenberg, Sales Mgr
Representatives in Principal Cities

Eclipse Fuel Engineering Company
Rockford Ill, 1100 Buchanan St, A C Perks, Pres ... 8-3751
J N Sands, Genl Sales Mgr
E E Magnuson, Sales Mgr Boilers and Vaporizers
R E Hayden, Sales Mgr Industrial Furnaces
Atlanta 5 Ga, 4825 Jett Rd NW, Gunsolus Eng Co ... CE 3-3812
Baton Rouge La, 6545 Kerr St, Stanley Hughes Co ... EL 7-6028
Billings Mont, 108 N 23rd St, Lefler Eng Sales ... 2-2105
Birm 3 Ala, 652 Brown Marx Bldg, Genl Combustion Co ... 54-6863
Boston (Waltham) Mass, Box 47, Etter Eng Co ... TW 3-8658
Buff 17 NY, Box 56 Kenmore Sta, E H Seelbach ... DE-4014
Charlotte 7 NC, 2617 Selwyn Ave, E L Mountcastle ... FR 5-0592
Chi 39 Ill, 4935 W Fullerton Ave, A A Engelhardt ... TU 9-6220
Cinn 29 O, 515 Melish Ave, Stelter & Brinck ... PL 1-0453
Cleve 15 O, 2036 E 22nd St, Gerow Equip Co ... MA 1-4570
Dallas 11 Tex, 4103 Shelley Blvd, Bishop Engrg Co ... FE 7-3621
Denver 4 Colo, 100 W 13th Ave, Slaybaugh-Thompson Co ... AC 2-0592
El Paso Tex, 609 Laurel St, Boyd Ind Engrg Co ... 3-7575
Det 19 Mich, 24450 Telegraph Rd, Harrison Engrg Co ... KE 2-1240
Grd Rpds 6 Mich, 1352 Franklin SE, E M Smith Co ... GL 2-5656
Indpls 18 Ind, 2323 N Sheridan, Loy Instr Co ... FL 7-7760
Knox Tenn, 1309 Broadway NE, Ferguson Equip Co ... 5-5244
Little Rock Ark, Term Warehouse Bldg, J L Brown Sales ... FR 4-5778
L A 39 Cal, 5469 San Fern Rd W, Thermal Eng & Equip ... CH 5-3795
Memphis 7 Tenn, 693 N 3rd St, Hoshall Machy Co ... JA 6-2052
Midland Tex, 2005 W Florida, Hy-Bon Engrg Co ... MU 2-2745
Moline Ga, 171 55th St, Cliff Soper Co ... MO 2-2089
Nashville Tenn, 1916 8th Ave, R E Gardner Co ... 4-8877
New Haven 9 Conn, Box 1944, Etter Engrg Co ... AT 8-1115
Omaha Neb, 1514 Davenport St, The Walling Co ... JA-7044
Phila 8 Pa, 401 N Broad St, L B Maximon ... WA 2-4845
Pgh 15 (Sharpsburg) Pa, 104 4th St, V C Leatherby ... ST 2-2222
Phoenix Ariz, 1612 W Weldon, Hennesy Equip Sales Co ... AL 8-4159
Roanoke Va, 1336 E Drive, E C Konkle Co ... 3-0043
Rockford Ill, 818 N Court St, Cliff Soper Co ... 4-1549
St Louis 17 Mo, 1700 Big Bend Blvd, Brandwine Equip ... ST 1-6432
St Paul 5 Minn, 1694 Grand Ave, Chas W Guptil ... MI 9-3995
S Bend 24 Ind, 2319 Erskine Blvd, A N Dunn ... AT 8-3901
S San Fran Cal, 225 Shaw Rd, Matheson-Doherty Co ... PL 5-7920
Tulsa 5 Okla, 1649 E 54th St, Bishop Engrg Co ... RI 2-2371
Yonkers NY, 30 S Broadway, A N Mason ... YO 8-8954
K C 12 Mo, 4638 Nichols Pkwy, Brandwine Equip Co ... LO 1-1666
Cranston 10 RI, Box 3554, Etter Engrg Co ... ST 1-5410
Newton Ia, 121 W 3rd St N, The Walling Co ... 143
Rich 19 Va, 106 S 3rd St, E C Konkle Co ... MI 7-1147
A D Wilcox, Sales Mgr Combustion Div
Atlanta 5 Ga, 4825 Jett Rd NW, Gunsolus Eng Co ... BL 5-3812
Baton Rouge La, 6545 Kerr St, Stanley Hughes Co ... EL 7-6028
Birm 3 Ala, 652 Brown Marx Bldg, General Combust Co ... 54-6863
Boston (Waltham) Mass, Box 47, Etter Engrg Co ... TW 3-8658
Buff 23 NY, 24 W Grimsby Rd, E H Seelbach ... DE-4014
Charlotte 9 NC, 2617 Selwyn Ave, E L Mountcastle ... FR 7-6719
Chi 39 Ill, 4935 W Fullerton Ave, A A Engelhardt ... TU 9-6220
Cinn 29 O, 515 Melish Ave, Stelter & Brinck ... PL 1-0453
Cleve 21 O, 4040 Mayfield Rd, W H Kay Co ... EV 1-3440
Cranston 10 RI, 2 Poplar Dr, Etter Engrg Co ... ST 1-5410
Dallas 11 Tex, 4103 Shelley Blvd, Bishop Engrg Co ... FE 7-3621
Deerfield Bch Fla, 1403 SE 8th Court, Don C Jackson
Denver 4 Colo, 100 W 13th Ave, Slaybaugh-Thompson Co ... AC 2-5826
Det 35 Mich, 20141 Jas Couzens Hwy, Ind Burner Sys ... VE 7-7821
Glendale 1 Cal, 1622 Kenneth Rd, Ind Comb & Furn Co ... CH 5-5394
Houston 4 Tex, 2801 San Jacinto, M K Griggs Co ... CA 8-8645
Indpls 18 Ind, 2323 N Sheridan, Loy Instr Co ... FL 7-7760
K C 12 Mo, 4638 Nichols Pkwy, Brandwine Equip Co ... LO 1-1666
Memphis 6 Tenn, 1565 Harbor Ave, Process & Power Inc ... WH 2-2353
Midland Tex, Box 2506, Hy Bon Engrg Co ... MU 2-2745
Milw 17 Wis, 105 E Henry Clay, Marshall Nelson ... ED 2-7561
Moline Ill, 171 55th St, Cliff Soper Co ... MO 2-2089
New Haven 9 Conn, Box 1944, Etter Engrg Co ... AT 8-1115
Newton Iowa, 121 W 3rd St N, The Walling Co ... 143
Omaha Neb, 1514 Davenport St, The Walling Co ... JA-7044
Phila 8 Pa, 401 N Broad St, L B Maximon ... WA 2-4845
Pgh 15 (Sharpsburg) Pa, 104 4th St, V C Leatherby ... ST 2-2222
Phoenix Ariz, 2401 E Elm St, Combustion Equip Co ... CR 4-4363
Port 13 Ore, 5329 NE Sandy Blvd, Kleenair Prods Co ... AT 7-1191
Rich 19 Va, 106 S 3rd St, E C Konkle Co ... MI 4-1147
Roanoke Va, 1336 E Drive, E C Konkle Co ... 3-0043
Rockford Ill, 818 N Court St, Cliff Soper Co ... 4-1549
St Louis 17 Mo, 1700 Big Bend Blvd, Brandwine Equip Co ... ST 1-6432
St Paul 5 Minn, 1694 Grand Ave, Charles W Guptil ... MI 9-3995
Salt L City U, 323 W 14th S, Control Equip Co ... HU 4-6011
Seattle 8 Wash, 812 Adams St, Brown Engrg Co ... MA-5420
S San Fran Cal, 225 Shaw Rd, Matheson-Doherty Co ... PL 5-7920
Tulsa 5 Okla, 1649 E 54th St, Bishop Engrg Co ... RI 2-2371
Yonkers NY, 30 S Broadway, A N Mason ... YO 8-8954
York Pa, 1225 Princess St, Combustion Heat & Power ... 2-8410
Dawthern Division
Houston 4 Tex, 2801 San Jacinto, M K Griggs Co ... CA 8-2261
Memphis 6 Tenn, 1565 Harbor Ave, Process & Power Inc ... WH 2-2353

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Thomas A Edison Industries, Instrument Division of McGraw Edison Company
West Orange, N J, William H Balentine ..... OR 3-6800
George J Bindewald, Sales Mgr Inst Div
Dallas Tex, 2520 W Mockingbird Lane, Bill McClung ..... FL 7-1380
Dayton O, 254 Med Arts Bldg, J W Reichert OR-2005
Park Ridge Ill, 417 Devon Ave, H E Van Cleef ..... TA 5-2136
Sherman Oaks Cal, 14652 Ventura Blvd, R J Sentenac ..... ST 4-8281
Tampa Fla, 3109 Bay to Bay Blvd, Carl Smith ..... TA 5-27361

Edward Valves Inc, Div of Rockwell Manufacturing Co
E Chi Ind, 1200 W 145th St, W F Crawford, Pres 231
R A Durand, Sales Mgr
Birm 9 Ala, 1812 28th Ave S (Homewood) J W Eshelman ..... TR 9-3462
Boston 10 Mass, 287 Congress St, Theodore S Ray ..... WO 1-2435
Buffalo 7 NY, 1807 Elmwood Ave, Victor J Williams DE-1873
Charlotte 3 NC, 300 E Tremont Ave, David Tobin BU-2850
Chi Ill, 1200 W 145 St (E Chi Ind), R N Thompson 231
Cinn 8 O, 3181 Linwood Rd, L E Trotter ..... TR 1-2288
Cleve 20 O, 1900 Euclid Ave, J M Watson ..... SU 1-6065
Detroit 16 Mich, 2615 12th St, Lloyd R Leatherman ..... WA 7-9731
Houston 26 Tex, 1606 Maury St, E T Wallace ..... CA 4-0863
Houston 1 Tex, 3711 Clinton Dr, J B Fargerson ..... CA 2-2351
Indpls Ind, 4000 E 16th St, Ernest A Grimmer ..... FL 6-8600
K C Mo, 1249 Burlington Ave, Orville W Barnett ..... GR 1-4747
L A 15 Cal, 864 S Robertson Blvd, P E Bradfield ..... BR 2-8151
Milw 13 Wis, 3074 N 79th St, Fred E Hoffman ..... HI 2-3510
Mpls Minn, 4029 Vernon Ave S, J L King ..... WA 7-9731
N Y 17 NY, 2712 Grand Cent Term, Wm B Osgood ..... LE 2-4732
Phila Pa, Main Line Prof Bldg, D J McDonald Jr
Pgh 8 Pa, 400 N Lexington Ave, W G Mahlman ..... CH 1-8400
Richmond 19 Va, 615 E Franklin St, I Russell Berkness 3-5357
Rochester 9 NY, 1038 Winton Rd N, John F Genthner BU-2850
St Louis 17 Mo, 26 Hanley Indus Ct, Werner K Bauer ..... MI 7-3250
Tulsa 1 Okla, 3130 Sand Spring Rd, H W Bierman ..... GI 7-5144

Eggelhof Engineers Incorporated
Houston Tex, 1912 Hussion St, Bob Molnari, Pres ..... CA 8-6471
Dallas Tex, 4331 Belmont Ave, Wilson Green ..... TA 4-2505
Lubbock Tex, 18th and Ave K, C E Menefee ..... PO 2-4330
N O La, 4524 Thalia St, Henry Turner ..... UN 6-4548
San Antonio Tex, N Main Ave, Jim Powell ..... CA 6-5506
Shreve La, 753 Gladstone, A L Jones 8-2451
Tulsa Okla, 1524 Hunt Bldg, Cliff Lindsey ..... LU 7-6048

Ehret Magnesia Manufacturing Company Incorporated
Valley Forge Pa, Samuel Garre Jr, Dir of Sales ..... GL 2-2611
Chi 1 Ill, 228 N LaSalle St, E E Drake ..... ST 2-3565
Houston 6 Tex, 4515 Devon, R M Skinner ..... MO 4-3706
N Y 17 NY, 18 E 41st, J A Wagg ..... OR 9-2746
Phila 32 Pa, 1315 Cumberland St, D L Satterthwaite ..... BA 9-6531

Ehrhart & Associates Inc
L A 13 Cal, 417 S Hill St, George W Ehrhart, Pres ..... MA 6-5371
W L Luzan, Sales Mgr
San Fran 11 Cal, 444 Mrkt St, C W Pace ..... YU 2-1016

Eimco Corporation
Salt L City U, 634 S 4th West St, J Rosenblatt, Pres ..... DA 8-8831
P O Richter, Sales Mgr Filters
Earl Kelly, Sales Mgr Process
L D Bernard, Sales Mgr Loaders
Berkeley Cal, 637 Cedar St, J K Russell ..... LA 6-6884
Birm Ala, 3140 Fayette, W L Dowdey ..... ST 7-2629
Butte Mont, 812 W Granite ..... BU 2-0683
Cleve O, 1836 Euclid Ave ..... PR 1-2131
Duluth 5 Minn, 1823 E Superior St, M D LaGrange ..... RA 8-2511
El Paso Tex, 1225 Mills Bldg, H W Foester ..... KE 3-1041
Grand Junction Colo, Box 153 ..... CH 2-9418
Houston 35 Tex, 5419 Sanford Rd ..... MO 4-0914
N Y 5 NY, 51 South St, M M Kaiser ..... WH 3-6890
Palatine Ill, 301 S Hicks Rd, P O Richter ..... FL 8-1100
Pgh 28 Pa, 666 Washington Rd ..... LE 1-4639
San Mateo Cal, 420 Peninsular Ave, A M Kivari
Seattle Wash, 208 Hoge Bldg MU-5084

Electric Machinery Mfg Co, Div of Worthington Corp
Mpls 13 Minn, 800 Central Ave, R H Olson, Pres ..... FE 9-6751
A P Burris, V Pres Sales
C E Buchan, General Sales Mgr
Allentown Pa, 2200 31st St SW, W A Lee ..... HE 5-9563
Atlanta Ga, 522 N McDonough St (Decatur) H W Thompson ..... DR 3-9611
Balt 18 Md, 333 E 25th St, P V Renoff ..... HO 7-3280
Beaumont Tex, 1050 Railroad, T J Moss ..... TE 3-2679
Birm 4 Ala, 700 8th Terrace W, W B Hanson Jr ..... FA 2-6511
Bluefield W Va, Box 33, J R Cameron ..... DA 7-7938
Boston 16 Mass, 131 Clarendon St, W H Brackett ..... CO 7-5333
Buffalo 25 N Y, 3493 Harlem Rd, F R Hedding WI-9200
Butte Mont, 829 Maryland Ave, R E McDonough 2-5447
Charlotte 2 NC, 116½ E 4th St, R Ranson ..... ED 4-4244
Chi 6 Ill, 20 N Wacker Dr, H T Thompson ..... ST 2-7153
Cinn 6 O, 2904 Woodburn Ave, J P Bergren ..... PL 1-1434
Cleve 14 O, 215 Euclid Ave, R H Kutscher ..... CH 1-6369
Corpus Christi Tex, 643 N Port Ave, W S Bailey ..... TU 2-9451
Dallas 2 Tex, 1314 Wood St,H L Renking ..... RI 8-1122
Denver 2 Colo, 1644 Blake St, M G Mueller ..... AC 2-3515
Detroit 21 Mich, 3117 W McNichols Rd, M F Knaus ..... DI 1-8686
Duluth 4 Minn, 6 S 36th Ave E, O A Bruneau ..... RA 4-2406
El Paso Tex, 511 Hawkins Way, R R Hynes ..... PR 2-3233
Grand Rapids 2 Mich, 614 Murray Bldg, M J Sandling ..... GL 9-8156
Houston 1 Tex, 4411 Navigation Blvd, L J Wallace ..... CA 5-6661
Indpls 4 Ind, 1211 Roosevelt Bldg, G A Wright ..... ME 5-1112
K C Mo, Muntzel-Keach Bldg (Mission Kan) W W Hesler ..... RA 2-6464
Knoxville Tenn, 234 Daylight Bldg, J G Pettyjohn 3-0111
L A 58 Cal, Box 58213, W C King ..... LU 3-1781
Milw 4 Wis, 700 S Fifth St, C L Harry ..... MI 5-5680
Mpls 13 Minn, 800 Central Ave, H N Sommer ..... FE 9-6755
N O 15 La, 1719 Toledano St, A W Betz ..... TW 5-8691
N Y 17 NY, 110 E 42nd St, J J Wall ..... OX 7-0955
Omaha 2 Neb, 14th and Farnam Sts, C R Bangh AT-4232
Phila 3 Pa, 1617 Penn Blvd, C G Smith ..... RI 6-7091
Phoenix Ariz, 625 W Madison St, J E Redmond ..... AL 4-8471
Pgh 22 Pa, 355 Fifth Ave, J R Rowe ..... AT 1-1186
Port 9 Ore, 1233 NW 12th Ave, J R Thompson ..... CA 3-7349
Richmond 1 Va, 304 E Main, H J Baer 2-3090
St Louis 8 Mo, 4378 Lindell Blvd, G N Harris ..... OL 2-2222
Salt L City 1 Utah, 550 W 7th So. St, C R Silver ..... EL 5-5378
San Fran 11 Cal, 420 Market St, F G Guthrie ..... EX 2-8296
Seattle 1 Wash, 2603 Western Ave, A C Petrich MU-4950
Spokane 3 Wash, E 706 Sprague Ave, H B Tinling ..... TE 8-8276
Syracuse 2 NY, Syracuse-Kemper Bldg, J B Shickel ..... HA 2-7857
Tampa 1 Fla, Box 445, P Flanagan 64-6131
Tulsa 1 Okla, 302 S Cheyenne, R F Riddle ..... LU 5-5624
Wash 6 DC, 1627 K St NW, R K Kyle ..... NA 8-9238
York Pa, Box 654, J L Souser 2-0217

Electro-Alloys Division, American Brake Shoe Company
Elyria O, Taylor St and Abbe Rd ..... FA 3-3202
Paul L McCulloch Jr, Division President
William D Raddatz, VP
Chi 6 Ill, 155 N Wacker Dr, Gordon Hanson ..... DE 2-2345
Det 9 Mich, 4600 Merritt Ave, Paul W Nye ..... TA 5-0131
Elyria O, Taylor St & Abbe Rd, Robt Denman ..... FA 3-3202
Houston 24 Tex, Box 19381, B F Coombs ..... HO 5-3404
N Y 36 NY, 530 Fifth Ave, Fred T Jordan ..... OX 7-7000
Pasadena Cal, 804 S Fair Oaks Ave, Nat Gas Equip Co ..... RY 1-9621
Phila 3 Pa, Suburban Sta Bldg, Walter Scott ..... RI 6-5395
Pgh 19 Pa, 717 Grant Bldg, Geo E Maley Jr ..... GR 1-3023

Electro Metallurgical Company, Division of Union Carbide Corp
N Y 17 N Y, 30 E 42nd St ..... MU 7-8000
Representatives in Principal Cities

Electronic Associates Incorporated
Long Branch NJ, L F Christianson ..... CA 9-1100
C J Marsh Jr, Dir of Sales
R L Yeager, Mgr Eastern Div
J D Kennedy, Mgr Central Div
J E McCloskey, Mgr Western Div
El Segundo Cal, 1500 E Imperial Hwy, W Kindle ..... EA 2-3220
Lg Branch N J, Lg Branch Ave, R L Yeager ..... CA 9-1100
Mt Prospect Ill, 101 S Pine St, J D Kennedy ..... CL 5-6070
N Hollywd Cal, 5437 Laurel Canyon Blvd, J E McCloskey ..... PO 3-1918
Princeton NJ, Box 582, R Favreau ..... PR 1-2291

Elliott Company, Division of Carrier Corporation
Jeannette Pa, W A Elliott, Pres ..... LA 3-5422
Atlanta 5 Ga, 3127 Maple Dr NE, F L Humphrey Jr ..... CE 3-4421
Boston 35 Mass, 1330 Soldiers Field Rd, H W Kinsel ..... AL 4-2443
Buff 2 NY, 170 Franklin St, L E Rau MO-3828
Charlotte NC, 1707 Liberty Life Bldg, W J Lyons ..... ED 3-9172
Chi 30 Ill, 6100 N Pulaski Rd, W E Widau ..... CO 7-7800
Cinn 6 O, 2337 Victory Pkwy, R V Thayer ..... CA 1-2035
Cleve 14 O, 1319 Natl City Bk Bldg, R W Fox ..... SU 1-9150
Dallas 6 Tex, 5738 N Cent Expwy, N W Frank ..... TA 4-8119
Denver 3 Colo, 655 Broadway Bldg, J H Petersen ..... AL 5-9722
Det 3 Mich, 800 W Seven-Mile Rd, R K Williams ..... FO 6-5669
Houston 3 Tex, 1209 Hutchins St, J D Willcox Jr ..... CA 8-8656
Indpls 18 Ind, 3721 Keystone Ave, J R Morgan ..... LI 7-7881
K C 14 Mo, 514 W 75th St, H J Campbell ..... DE 3-2688
L A 15 Cal, 714 W Olympic Blvd, V A Peterson ..... RI 9-1074
Milw 3 Wis, 744 N 4th St, L A Wells ..... BR 1-9191
Mpls 23 Minn, 2101 W 78th St, H D Mateffy ..... UN 6-8795
N O 13 La, 256 Lee Circle Bldg, G C Bayles ..... JA 5-2662
Newark (Bloomfield) NJ, 400 Bloomfield Ave, J C Carney ..... HU 3-7000
N Y 13 NY, 271 Church St, C L Hoebel ..... WO 4-7880
Phila 2 Pa, 226 S 16th St Bldg, J R Lemmon ..... KI 6-2215
Pgh 19 Pa, 718 Frick Bldg, S W Crisman ..... AT 1-5000
Rockford Ill, 401 W State St, R P Borden ..... RO 4-5834
St Louis 3 Mo, 1221 Locust St, H W Honefenger ..... CH 1-6413
San Fran 4 Cal, 120 Mongomery St, H P Hostetter ..... SU 1-2812
Seattle 1 Wash, 1101 Vance Bldg, H R Bushley EL-6385
Tulsa 3 Okla, 222 Mayo Bldg, J N McClure ..... DI 3-4187
Wash 1 DC, 740 11h St NW, M L Hiller ..... RE 7-3411

Emery Industries Incorporated
Cinn 2 O, 4200 Carew Tower, A W Schubert, Exec VP ..... DU 1-5700
R F Brown, Sales Mgr Organic Chem Dept
G W Boyd, Sales Mgr Fatty Acid Sales Dept
C W Sampson, Sales Mgr Export Dept
Charlotte 2 NC, 617 Prof Bldg, W A Colby ..... ED 2-1828
Chi 1 Ill, 221 N LaSalle Ave, J E Quinty ..... CE 6-2737
Cleve 13 O, 1200 W 9th St Rm 213, W J Siemens Jr ..... TO 1-5270
Lowell Mass, Box 348, A R McDermott ..... GL 8-8922
N Y 7 NY, 3002 Woolworth Bldg, H D Armitage ..... CO 7-4393
Phila Pa, 401 N Broad St, J P Clancy ..... WA 5-8811
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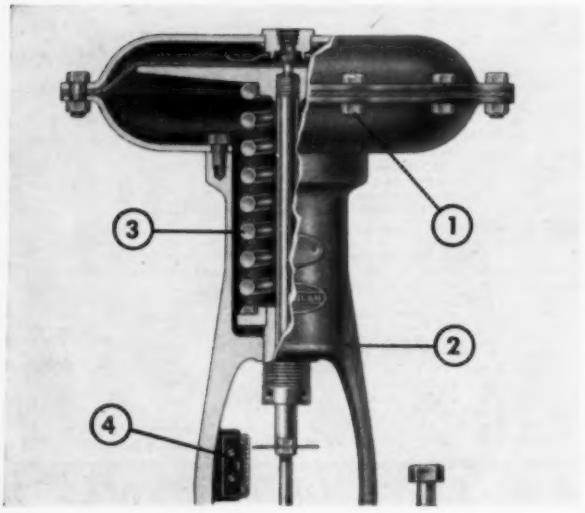

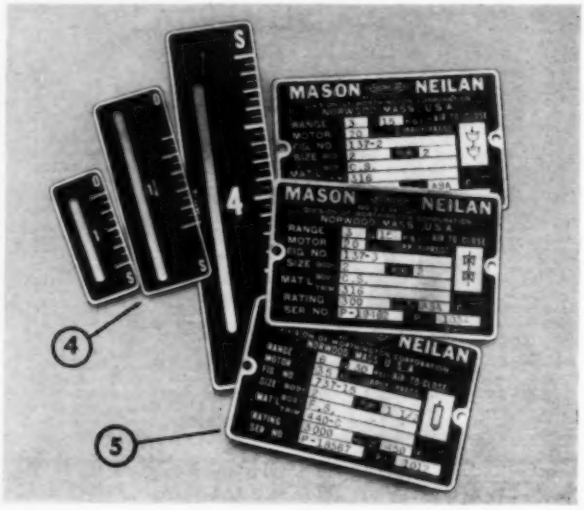

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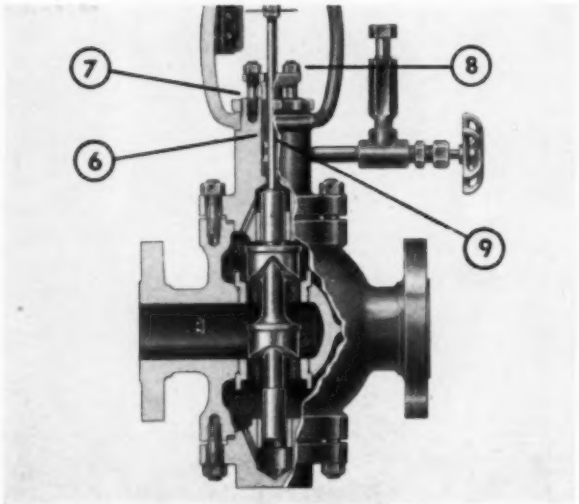

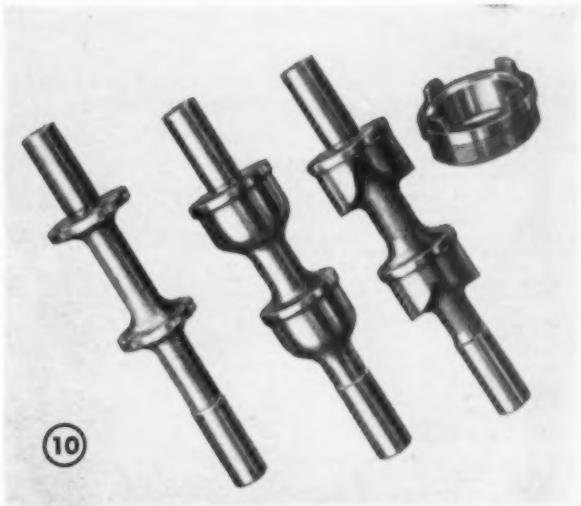

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N Y 17 NY, 60 E 42nd St, Jack Orr ..... MU 7-3566
Midland Tex, 1204 Wilco Bldg, Robt Spellman ..... MU 2-0423
Tulsa 3 Okla, 915 First Natl Bldg, Larry Harper ..... LU 4-4185

Frick Company
Waynesboro Pa, W Main St, D N Benedict, Pres 1245
W H Aubrey, Sales Mgr Refrig & Air Cond Div
Atlanta 3 Ga, 1003 Mart Guar Bldg, C P Goree ..... JA 2-4563
Boston 15 Mass, 419 Commonwealth Ave, R S Ziehmn ..... CO 7-1313
Charlotte 2 NC, 1013 Independence Bldg, A B Hoppe ..... ED 2-5742
Cinn 2 O, 2409 Carew Tower, J A Etter ..... MA 1-2070
Dallas 1 Tex, 805 Tower Pet Bldg, J C Rust ..... RI 2-6373
K C 8 Mo, 611 Mdse Mart Bldg, V J Sparks ..... HA 1-6066
L A 14 Cal, 656 S L A St Rm 702, W F Losch VA-9632
Memphis 3 Tenn, 1012 Sterick Bldg, H B Phelps ..... JA 5-1213
N O 12 La, 238 Loyola Ave, John T Sanders III TU-2003
N Y 17 NY, 370 Lex Ave, J T Murphy ..... MU 3-1936
Okla City 5 Okla, 220 NE 38th St, G M Gasore ..... JA 5-1072
Palatka Fla, 113 Abstract Bldg, Weldon Henley ..... EA 5-2631
Palo Alto Cal, 809 San Antonio Rd, A J Vandermade ..... YO 8-2868
Phila 4 Pa, 408 Wilford Bldg, Cyril Leech ..... BA 2-7112
Pgh 22 Pa, 907 Empire Bldg, P A Willis ..... AT 1-4025
St Louis 3 Mo, 1221 Locus St, J H Carter ..... GA 1-2234
Wash 5 DC, 1226 Shoreham Bldg, W J Dugas ..... EX 3-1737

Fritzsche Brothers Incorporated
N Y 11 NY, 76 Ninth Ave, John L Cassullo, Pres ..... WA 9-4100
Chi 10 Ill, 118 W Ohio St ..... SU 7-1848
Cinn 2 O, 2306 Carew Tower, Walter M Eller ..... MA 1-5143
Decatur Ga, 403 W Ponce de Leon Ave, George Fellows ..... DR 3-9452
L A 17 Cal, 816 W 8th St, Stanley Crouch TR-8359
Norwood Mass, 661 Wash St, T Fred Baker Jr ..... NO 7-3303
Phila 7 Pa, 12 S 12th St, J F Shumaker ..... WA 2-4131
S Louis 5 Mo, 8032 Forsythe Blvd, F A Barada ..... VO 3-3520
San Fran 5 Cal, 395 Monadnock Bldg, Parker Schwamb ..... GA 1-0838

Fuller Company
Catasauqua Pa, 124 Bridge St, A E Douglass, Pres ..... CO 4-2841
C C Kaesemeyer, Genl Sales Mgr
E P Meixsell, Sales Mgr Compressor Div

H B Fuller Company
St Paul 2 Minn, 255 Eagle St , RE Foley, Div Mgr ..... CA 2-0505

Atlanta Ga, 655 Mead St, W R Mattox ..... MA 7-1939
Buff NY, 1934 Elmwood Ave, G McDougall RI-6366
Chi 22 Ill, 904 W Blackhawk St, J McIntyre ..... MI 2-6300
Cinn O, 4020 Cherry St, H B Fuller Jr ..... MU 2-5420
Dallas Tex, 2217 Laws St, G Ryberg ..... RI 7-7315
K C Mo, 915 Broadway, G Ryberg ..... VI 2-9887
Linden NJ, 1201 Fuller Rd, N Liggett ..... WA 5-2272
Memphis Tenn, 802 Royal Ave, C Cramer ..... JA 6-4212
S San Fran Cal, 57 S Linden Ave, D F Bartholmess ..... PI 6-5450
St Paul Minn, 1144 Eustis St, E A Vigard ..... MI 6-8641

Fulton Sylphon Division, Robertshaw-Fulton Controls Company
Knoxville 1 Tenn, F G Cross, Vice Pres 4-1641
G L Ogdin Jr, Genl Sales Mgr
L S Dysart, Sales Mgr Controls Div
Albany 10 N Y, 52 S Swan St, Dan Mason ..... AL 4-0111
Albuquerque NM, 112 W Granite Ave, Boyd Engrg Co 3-2247
Atlanta 3 Ga, 314 Buckhead Ave NE, Thermal Engrg Co EX-8664
Balt 18 Md, 3411 Old York Rd, J D Crum ..... BE 5-9306
Birm 5 Ala, 1107 7th Ave S, Haydn Myer Co ..... FA 2-5645
Boston Mass, 238 Main St Cambridge 42, C R Carter ..... TR 6-5577
Colchester Vt, Coffey and Teachout ES-2117
Prov RI, 157 Orchard St, Roy I Adams ..... WI 1-9059
Camden 3 NJ, 22 Haddon Ave, Arthur G Baitz ..... WO 6-2498
Charlotte 1 NC, 711 Clement Ave, Chas M Setzer & Co ..... ED 2-3550
Chi 11 Ill, 568 Wrigley Bldg, N W Barnes & Co ..... WH 4-6552
Cinn 6 O, 2910 Woodburn Ave, D R Prince ..... CA 1-2312
Charleston 1 W Va, Box 747, W H Ellis .....
Cleve 18 O, 1991 Lee Rd, C O Pettersson Inc ..... YE 2-6242
Denver 4 Colo, 1051 11th St, Herman & von Rosenberg ..... AC 2-2833
Det 21 Mich, 8406 W McNichols Rd, Geo F Schnell ..... UN 3-2400
Greensboro NC, 215 E Wash St, Richard K Hunter & Co 2-0800
Houston 3 Tex, Box 1743, Eggelhof Engineers Inc ..... CA 8-6471
Indpls 2 Ind, 1531 N Penna St, Jackson Engrg Co ..... ME 4-3463
K C 8 Mo, 1735 Locust St, Kirk Campbell ..... VI 2-2315
Knoxville 12 Tenn, 702 Empire Bldg, C F Sexton 3-9219
L A Cal, 3101 Imperial Hwy Lynwood Cal, D D Gordon ..... NE 6-9791
Louisville 2 Ky, 604 W Main St, Allan K Cook ..... JU 7-1269
Marshalltown Ia, Kresge Bldg, R S Stover Co 5557
Memphis 3 Tenn, 668 S Main St, T J O'Brien Engrg Co ..... JA 6-0339
Milw 6 Wis, 2465 W Fond du Lac Ave, N W Barnes & Co ..... HI 2-1220
New Haven 17 Conn, Box 6157, The Hoyt-Grant Co ..... CH 8-4447
N Y 7 NY, 50 Church St, King & Shepherd Inc ..... CO 7-1456
Omaha 2 Neb, 1903 Jones St, D E McCulley Co WE-6373
Orlando Fla, 214 Church, Roger Macnamara 2-2252
Phila 7 Pa, 121 N Broad St, Sheffler-Gross Co ..... LO 4-5750
Phoenix Ariz, 630 E Broadway, John W Ladlow ..... BR 6-2371
Pgh 2 Pa, 547 Lincoln Ave Bellevue, Keystone Sales ..... PO 1-0626
Port 4 Me, Box 654, Crosby & Siegars Inc ..... SP 4-1481
Port 4 Ore, 317 Builders Exch Bldg, Bert Farnes Co ..... CA 7-1766
Rich 19 Va, 300 E Main St, W H Kidd & Co 2-9240
St Louis 3 Mo, 2832 Olive St, O'Brien Equip Co ..... JE 3-2091
St Paul 5 Minn, 2144 Summit Ave, L G Wynn & Assoc ..... MI 9-2281
Salt L City 4 Utah, 44 W 8th So St, Midgley-Huber Co 22-2537
San Fran 3 Cal, 765 Minna St, Norman Brown Co ..... UN 1-0144
Seattle 9 Wash, 314 9th Ave N, Heating Serv Co MA-8660
Spokane 1 Wash, W 915 Mellon Ave, Frederick Co BR-1444
Wash 6 DC, 1625 Eye St NW, J T Jones ..... DI 7-1379

G

Gardner-Denver Company
Quincy Ill, Front St, G V Leece ..... BA 2-5400
G W Gutekunst, VP-Sales
R J Marshall, Sales Mgr Oilfield Div
Dallas 35 Tex, 7125 Harry Hines Blvd, R J Bauer ..... FL 7-2817
Denver 1 Colo, 1727 E 39th Ave, H F Gerhauser ..... AC 2-9393
Houston Tex, 2201 Polk Ave, J L Speece ..... CA 7-9295
K C 14 Mo, 309 W 79th Terrace, M G Handly ..... DE 3-3233
L A 22 Cal, 7654 E Slauson Ave, W A Nillson ..... RA 3-8711
N O 25 La, 7735 Edinburgh St, M B Morrisette AM-3756
Pgh 26 Pa, 520 McNeilly Rd, D C Nichols ..... LO 1-6011
Robertson (St Louis) Mo, 6011 N Lindberg Blvd, J Bird ..... PE 1-2220
Tulsa 16 Okla, 6746 E 11th St, R G Caldwell ..... TE 5-1531

Garlock Packing Company
Palmyra NY, 402 Main St, R M Waples, Pres ..... LY 7-4811
J Bert Sewell, Sales Mgr
Balt 18 Md, 2828 Loch Raven Rd ..... TU 9-2686
Birm 1 Ala, 519 S 19th St, F V Bailey 4-7666
Boston 10 Mass, 80 Broad St, R C Wagner ..... HA 6-4590
Chi 6 Ill, 600 W Jackson Blvd, C F Palmer Jr ..... RA 6-6716
Cinn 16 O, 8329 Vine St VA-5913
Cleve 13 O, 1276 W 3rd St, F E Erlandson ..... MA 1-0310
Denver 2 Colo, 1863 Wazee St, W A Reynolds ..... AC 2-0649
Det 11 Mich, 2781 E Grand Blvd, E M Thomas ..... TR 3-6160
Houston 10 Tex, 2409 Sabine St, W L Mikell ..... FA 3-6368
L A 21 Cal, 2303 E 8th St, J H Dunlevy TR-8448
N O 25 La, 3525 Lowerline St AU-0831
N Y 6 NY, 114 Liberty St, A E Munch ..... BA 7-1124
Phila 2 Pa, 20 S 15th St, E G Flannery ..... LO 7-7010
Pgh 22 Pa, 933 Penn Ave, P D Yates ..... CO 1-2222
Port 9 Ore, 1036 NW 18th Ave ..... CA 8-7649
Salt L City 1 Utah, 322 Dooly Bldg ..... EM 3-5535
San Fran 7 Cal, 750 18th St, W E Crowley ..... HE 1-0370
St Louis 8 Mo, 3635 Forest Pk Blvd, A C Gustafson ..... OL 2-3157
Seattle 4 Wash, 814 Lane St ..... MA 3-6358
Spokane 4 Wash, W 610 Second Ave MA-6632
Tulsa 20 Okla, 816 E 6th St ..... LU 3-5715

Gar Wood Industries Incorporated
Wayne Mich, E F Fisher, Pres
H H Hippler, Sales Mgr Wayne Div
D J Davis, Sales Mgr Findlay Div

Gas Atmospheres Incorporated
Cleve 16 O, 20011 W Lake Rd, C F Olmstead ..... ED 1-7070
W H Boyd, Sales Mgr
Chi 11, 416 N State St, Wm G Praed ..... DE 7-3718
Houston Tex, 49 San Jacinto St, J D Isaacks ..... FA 3-3554
Hartford 12 Conn, 296 Homestead Ave, D W Rockwell ..... CH 6-5622
New Britain Pa, A C Read ..... FI 8-2215

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Omaha Neb, 4802 Douglas St, Gordon Erickson RE-0898
Rocky River 16 O, 1839 Wynwood Dr, Harlen F Muro ..... ED 1-1447
St Louis 8 Mo, 3909 Olive St, B M Brownell ..... JE 1-1533
S Gate Cal, 4020 Firestone Blvd, R R Derber ..... LO 7-1384
Tacoma Wash, 11703 Mountbrook La, F Larson LA-0344
Tulsa Okla, Box 7098, Frank Thomas ..... RI 7-4541
Union N J, 2165 Morris Ave, Geo S Ewing ..... MU 6-1747

Gasoline Plant Construction Corporation
Houston 2 Tex, 253 Esperson Bldg, M H Kotzebue, Pres ..... CA 2-0302

Gates Engineering Company
Wilm Del, 100 South West St, A J Seiler ..... OL 6-9951
G P Kern Jr, VP-Sales

General American Transportation Corporation
Chi 90 Ill, 135 S LaSalle St, W J Stebler, Pres ..... FI 6-4100
R G Biesel, Sales Mgr Plate & Welding Div
J Selig, Sales Mgr Tank Storage Terms Div
H E Coyl, Sales Mgr Tank Car Div
Birm Ala, 3017 N 35th St, C R Walcher
Cleve O, Term Tower, R M Lamport
Compton Cal, 2966 E Victoria St, H J Thompson
Dallas Tex, First Natl Bk Bldg, T C Moss
Houston Tex, Bk of the SW Bldg, J D Camp
N O La, 210 Baronne St, D E Johnson
N Y NY, 380 Mad Ave, S Frisch
Pgh Pa, 2600 Koppers Bldg, J A Ross
San Fran Cal, 235 Montgomery St, D E Matheny
Seattle Wash, Jos Vance Bldg, E J Doyle
Tulsa Okla, First Natl Bk Bldg, J C Wallace

General Cable Corporation
N Y 17 NY, 420 Lex Ave, J R MacDonald, Pres ..... LE 2-2920
Albuquerque NM, 2100 Zearing NW, L V Brown ..... CH 7-0547
Amarillo Tex, 323 N Nelson St, E C Hazard ..... DR 6-4396
Atlanta 18 Ga, 1401 Ellsworth Dr NW, E J Harvey ..... SY 4-7621
Balt 18 Md, 1130 E 30th St, H V Wrasse ..... TU 9-6544
Birm 5 Ala, 3508 4th Ave S, D L Cumbaa ..... AL 2-1171
Boston Mass, 120 VFW Pkwy, Revere 51 Mass, M J A Dugan ..... RE 8-6700
Bristol Tenn, 21 Spruce St
Buff 2 NY, 17 Court St, L Lind CL-4250
Chi 40 Ill, 5447 N Wolcott Ave, G S Ricker ..... UP 8-7600
Cinn O, 8475 Blue Ash Rd, Rossmoyne O, C B Deeds ..... PO 1-3258
Cleve 14 O, 2875 Superior Ave, W P Ellsworth ..... MA 1-5790
Col 12 O, 1140 Chambers Rd, K C Starkey ..... HU 8-9781
Dallas 7 Tex, 1620 Oak Lawn, W G Halsey ..... RI 1-9888
Dayton 4 O, 1256 Stanley Ave, R A Young HE-6749
Denver 16 Colo, 4201 E 48th Ave, N E Mains ..... FL 5-5323
Des Moines Ia, 2050 Del Ave, E J Holton ..... AM 5-0313
Det Mich, 12811 Cap Ave, Oak Pk 37 Mich, E B Sydnor ..... JO 6-7992
El Paso Tex, 1042 East Side Blvd, P L Vincent ..... PR 2-7495
Erie Pa, 1001 State St, K T Smith ..... ER 5-2168
Evansville Ind, 11 NW 2nd St, C E Hoskinson ..... HA 3-4403
Greensboro NC, 1304 Battleground Ave, F G Speidel
Houston 20 Tex, 1340 Hahle St, R S Millikan ..... WA 8-2491
Indpls 7 Ind, 1735 W 18th St, W C Gerlib ..... ME 2-6585
Jackson Mich, 3507 Wayland Dr, J W Ratchford ..... ST 4-0501
Jacksonville 5 Fla, 455 Roberts St, G A Williamson ..... EV 8-2685
K C 16 Mo, 920 Cable Rd, J H Motherway ..... BA 1-4788
Lincoln Neb, 5615 Seward St, R E Kirk ..... LI 6-1941
L A 58 Cal, 2906 Leonis Blvd, J E Moore ..... LU 2-8327
Memphis 6 Tenn, 1792 Latham St, T C Hannum ..... WH 8-4562
Miami 42 Fla, 3501 NW 60th St, J B Clark ..... NE 5-0382
Milw 13 Wis, 6520 W State St, P J Wanzek ..... GR 6-9638
Mpls 20 Minn, 404 W 79th St, H S Coleman ..... TU 1-5855
Newark N J, 1071 Hudson St, Union NJ, A L Rountree ..... MU 8-1130
New Haven Conn, 463 Boston Post Rd, Orange Conn, D H Phelps ..... SY 9-2381
N O 25 La, 3923 Euphrosine St, W W Bednarz TU-6217
N Y 17 NY, 420 Lex Ave, D W Freeman ..... MU 2-2920
Phila Pa, 95 S Eagle Rd, Havertown Pa, R J Fitzgerald ..... HI 7-1655
Phoenix Ariz, 3316 E Wash St, C E Manatt ..... BR 5-5401
Pgh 12 Pa, 2242 Cal Ave, T L James ..... FA 2-6533
Port 10 Ore, 2215 NW Quimby St, C W Barnes ..... CA 7-5556
Raleigh NC, 1325 Boone St, E G Speidel
Rich 21 Va, 2315 Westwood Ave, W R Ivey ..... RI 5-7808
Roch 4 NY, 42 East Ave, S E Sliwka ..... BA 5-5250
Rome NY, Railroad St, F W May ROME-1000
Sacramento 21 Cal, 915 Fee Dr, D H Buckley ..... WA 2-5881
St Louis 9 Mo, 4983 Fyler Ave, W W Neumeyer ..... PL 2-6400
Salt L City 4 Utah, 22 Jeremy St, J E Smith ..... DA 2-5829
San Ant 10 Tex, 311 Eads Ave, G M McCaskill ..... LE 2-6363
San Diego Cal, 520 E St, D G Sutton ..... BE 4-8538
San Fran 24 Cal, 185 Ind St, J J Reilly ..... MI 8-4140
Savannah Ga, Sav Ind Pk, Box 3487, J A Alsing ..... AD 6-1594
Seattle 4 Wash, 1137 W Hanford St, R E Roberts MA-4271
Springfield Ill, 920 N MacArthur Blvd, O J Binnette ..... SP 2-7705
Syracuse NY, Wavel St, E Syracuse NY, J C Ryfun ..... HO 3-4588
Tampa 10 Fla, 2515 E Hanna Ave, E B Lucas ..... TA 3-6575
Tulsa 5 Okla, 6848 E 41st St, D B Mathers ..... RI 2-2496
Wash 1 DC, 261 Constitution Ave NW, E C Goretzka ..... DI 7-7717
Wichita Kans, 255 N Main St, H V Lemon ..... FO 3-2165

General Chemical Division, Allied Chemical & Dye Corporation
N Y 6 NY, 40 Rector St, I H Fooshee, Pres ..... HA 2-7300
J P Farrell, Dir of Sales
Albany 5 N Y, Railroad Ave, K S Howland ..... AL 2-4469
Atlanta 3 Ga, 133 Carnegie Way NW, A B Connelly ..... MU 8-1278
Balt 30 Md, 2000 Race St, P N Shellenberger ..... PL 2-5030
Birm 4 Ala, 642 3rd Ave N, J T Wiegand ..... FA 2-3601
Bridgeport Conn, 850 Norman St, H R Farrell ..... ED 4-9419
Buff 2 N Y, 1 W Genesee St, S A Russell MA-4178
Charlotte 1 NC, 818 Tuckaseegee Rd, J C Bradley ..... ED 4-7226
Chi 54 Ill, 430 Mdse Mart, J W Kelley ..... MI 2-1800
Cleve 15 O, 3121 Euclid Ave, H T Zeising ..... HE 2-2020
Cleve Miss, Drawer 952, F L Bailey ..... VI 3-4065
Denver 9 Colo, 1271 W Bayaud Ave, W D Aust ..... SP 7-2623
Houston 11 Tex, 323 S 67th St, E R Lett ..... WA 8-3267
Jacksonville 3 Fla, Box 2057 ..... PO 5-1100
Kalamazoo 13 Mich, 511 E Paterson St, L M Kardes ..... FI 5-8676
L A 5 Cal, 2999 W 6th St, W A Peters Jr ..... DU 8-3201
Medford 55 Mass (Boston) Box 68, J J Greenhatch ..... MY 6-3568
Milw 3 Wis, 205 S 16th St, D W Ingraham ..... MI 5-3516
Mpls 13 Minn, 2020 Broadway St NE, S Slaney ..... ST 1-9581
N Y 6 NY, 261 Mad Ave, F C Hitchings ..... HA 2-7300
Phila 7 Pa, 12 S 12th St, W E Houghton ..... WA 2-1234
Pgh 22 Pa, 3 Gateway Ctr, J B Fuller ..... EX 1-1235
Prov 1 RI, 58 Weybosset St, J W Houston ..... DE 1-2366
River Rouge 18 Mich (Det) 800 Marion Ave, O W Svenson ..... VI 2-1500
St Louis 3 Mo, 1221 Locust St, J M Blalock ..... CH 1-3870
San Fran 4 Cal, 235 Montgomery St, W L Hoefling ..... YU 2-6840
Seattle 1 Wash, 1326 5th Ave, H C Hansen EL-5287
Wenatchee Wash, 3 Benton St, L E Henriksen WE-1703
Yakima Wash, Box 1468 ..... GL 7-4712

General Controls Company
Glendale 1 Cal, 801 Allen Ave, William A Ray, Pres ..... VI 9-2181
Sumner B Ladd, Sales Mgr Ind Controls Div
Ken McBain, Sales Mgr Tork-Master Div
J E Flickinger, Sales Mgr Electronic Controls Div
Ed Dahl, Sales Mgr Hammel-Dahl Div
Atlanta Ga, 1479 Spring St NW, George Deys ..... TR 6-4419
Balt 24 Md, 534 S Conkling, Frank Hodgins ..... OR 5-7800
Boston 59 Mass, 367 Boylston Newton Ctr, John Boyle ..... BI 4-8160
Buff 23 NY, 960 Kenmore Ave, Ken Weiti VI-0110
Charlotte NC, Route No. 3, W B Young ..... JA 3-2576
Chattanooga 4 Tenn, 1805 McCallie Ave, John Dickson ..... OX 8-2012
Cinn 2 O, 307 E 4th St, Jack Hurd ..... PA 1-8162
Cleve 3 O, 4317 Chester Ave, Wm Roecker ..... EX 1-0555
Col 12 O, 1219 W 3rd Ave, R Parsons ..... AX 4-4266
Dallas 7 Tex, 1804 N Ind Blvd, A E Hess ..... RI 1-3494
Denver 4 Colo, 1162 Elati St, J Ferguson ..... CH 4-6776
Des Moines 11 Ia, 2300 Cottage Gr Ave, M Dessauer ..... AT 8-4325
Det 27 Mich, 15114 Plymouth Rd, Geo Williams ..... VE 5-5625
Glendale 1 Cal, 801 Allen Ave, R M Johnson ..... VI 9-2181
Hartford Conn, 410 Asylum St, R Le Fevre ..... CH 7-0300
Houston 6 Tex, 3607 S Sandman St, R C Servat ..... JA 3-5671
Indpls 22 Ind, 2806 W 16th St, R Matz ..... ME 6-2537
Iron Mtn Mich, C Dunkel 2910
Kans City 8 Mo, 2904 Oak St, R C Allen ..... JE 1-2400
Long Is City 1 N Y, 31-31 Thomson Ave, R L Strongman ..... EX 2-3880
Milw 15 Wis, 3812 W Burnham St, R Kurrasch ..... OR 1-4940
Mpls 26 Minn, 6522 Walker St, H C Lindstrom ..... WE 9-7111
N O 25 La, 4028 Thalia St, J Babcock TU-8247
Omaha 2 Neb, 610 Keeline Bldg, Al Carpenter AT-3416
Phila 4 Pa, 4028 W Girard Ave, W Darragh ..... EV 6-4445
Phoenix Ariz, 124 E Roosevelt, V Dahl ..... AL 3-1368
Pgh 22 Pa, 4 Smithfield St, C C Tischler ..... CO 1-3858
Port 14 Ore, 1620 SE Hawthorne Blvd, I Parri ..... BE 4-9373
St Louis 10 Mo, 1330 Hampton Ave, L Miller ..... MI 7-4702
Salt L City 1 Utah, 353 W 4th St S, F Smith ..... EL 5-7611
San Fran 7 Cal, 600 Bryant St, W M Lewis ..... SU 1-7580
Seattle 9 Wash, 925 Westlake Ave N, W R Nason EL-0045
Skokie Ill, 8080 McCormick Blvd, B L Lerch ..... IR 8-2323
Syracuse 2 N Y, 317 State Tower Bldg, L Schnall ..... HA 2-2083
Tampa Fla, 409 E Cass St, C O'Barr 2-7488
Tulsa 20 Okla, 1316 S Peoria Ave, D D Shaddox ..... DI 3-0054
Wichita 2 Kans, 352 N Broadway, J Rapp ..... AM 7-9845

General Electric Company
Schenectady 5 NY, 1 River Road ..... FR 4-2211
Atlanta 9 Ga, 1860 Peachtree Rd NW ..... TR 6-2451
Balt 1 Md, 111 Park Ave ..... MU 5-6500
Baton Rouge 6 La, 3170 Florida Blvd 3-7561
Beaumont Tex, 1385 Calder Ave 2-8453
Billings Mont, 303 N Brdwy 2-2051
Chi 80 Ill, 840 S Canal St ..... WA 2-5611
Cinn 6 O, 2621 Victory Pkwy ..... PA 1-3431
Cleve 4 O, 4966 Woodland Ave ..... EN 1-4464
Corpus Christi Tex, 205 N Chaparral ..... TU 4-4933
Dallas 2 Tex, 1801 N Lamar St ..... RI 1-9121
Des Moines 9 Ia, 505 W Fifth Ave 3-0194
Detroit 2 Mich, 700 Antoinette St ..... TR 2-2600
El Paso Tex, 215 N Stanton St 3-7553
Gulfport Miss, 207 Jo-Fran Bldg 346
Houston 1 Tex, 1312 Live Oak St ..... CA 5-0261
Lake Charles La, 422 7th St ..... HE 3-3116
Little Rock Ark, 103 W Capitol Ave ..... FR 5-1273
L A 54 Cal, 212 N Vignes St ..... MA 5-7381
Milw 3 Wis, 940 W St Paul Ave ..... BR 1-5000
N Y 22 NY, 570 Lexington Ave ..... PL 1-1311
Phila 2 Pa, 3 Penn Center Plaza ..... LO 8-1800
Phoenix Ariz, 220 Luhrs Tower ..... AL 8-7724
Pgh 22 Pa, Oliver Bldg, Mellon Sq ..... AT 1-6400
Sacramento 14 Cal, 626 Forum Bldg ..... GI 3-1788
St Louis 1 Mo, 818 Olive St ..... GE 6-4343
Salt Lake City 9 Utah, 200 S Main St 4-1891
San Antonio 5 Tex, 434 S Main Ave ..... CA 6-8349
San Diego 1 Cal, 1240 Seventh Ave ..... BE 3-6461
San Francisco 6 Cal, 235 Montgomery St ..... DO 2-3740
Shreveport La, 206 Beck Bldg 3-8554
Tacoma 1 Wash, 1019 Pacific Ave BR-8361
Tulsa 3 Okla, 320 S Boston Ave ..... LU 5-8267
Wichita 2 Kan, 200 E First St ..... AM 7-4263

General Electric Company, Construction Materials Division
Bridgeport 1 Conn, 1285 Boston Ave 4-1012
J O Overstreet, Sales Mgr Wire and Cable
R E Elmendorf, Sales Mgr Conduit Products

General Tire and Rubber Company, Chemical Division
Akron 9 O, 1708 Englewood Dr, W O'Neil, Pres ..... RE 3-6311
Geroge Hackim, Mgr Vinyl Resin and Latex Sales
L W Reeves, Mgr Synthetic Rubber and Chem Sales
Ashtabula O, Box 88, P J Wallace ..... WY 3-2104
Mogadore O, Cleve Ave, J A Kleinhans ..... RE 3-6311
Odessa Tex, Box 2032, J A Pollock ..... FE 2-1462

Gilbert and Barker Manufacturing Company
W Springfield Mass, Cold Spring Ave, I C Jacobs, Pres ..... RE 3-4161
J A MacDonnell, VP-Mrktg and Prod Dev
Lawrence Marchese, Gen Sales Mgr
Fred E Neef Jr, Mrktg Sales Mgr
Chi 5 Ill, 600 S Mich Ave, E J Walters ..... HA 7-2727
Louisville 2 Ky, Starks Bldg, W D Crosby ..... JU 4-8580

Advertisement in this issue, index is on page A-6.

COMPANY DIRECTORY

N Y 10 NY, 15 W 51st St, J F Deitz ..... CI 7-0013
San Fran 5 Cal, 55 New Mont St, A C Stone Jr ..... YU 2-3871

Girdler Company, Division of Natural Cylinder Gas Company
Louisville 11 Ky, 2820 W Bwy, Howard D Hartough, Mgr ..... SP 8-4421
John W Benedict, Sales Mgr Chemical Products Div

Girdler Construction Division, National Cylinder Gas Company
Louisville 1 Ky, Comm Life Bldg, W R Wood ..... JU 7-7552
L E Osmer, Sales Mgr
N Y 38 NY, 150 Bwy Rm 2301 ..... WO 2-4184
San Fran 4 Cal, 2612 Russ Bldg, Arne Ericksen ..... GA 1-2594

Glidden Company
Cleve 14 O, 900 Un Comm Bldg, A D Duncan, VP-Paint Div ..... PR 1-5121
G B Richardson, Sales Mgr Ind Maint Div

B F Goodrich Industrial Products Company, Division of B F Goodrich Company
Akron 18 O, 500 S Main St, C O DeLong ..... BL 3-1171

Fritz W Glitsch and Sons Incorporated
Dallas Tex, 4900 Singleton Blvd, H C Glitsch, Pres ..... FE 1-3221
M C Glitsch, VP-Sales
Chi Ill, 7530 N Sheridan Rd, H L Wimpee ..... AM 2-6196
Cleve O, 313 Engrs Bldg, Nat Nesbitt ..... CH 1-5292
Houston Tex, 2480 Times Blvd, Tom E Wright ..... JA 8-1507
Louisville Ky, 2416 Frankfort, Reg Silby ..... TW 5-5389
L A 57 Cal, 1901 W 8th St Rm 202, S G Higginbotham ..... DU 1-3846
N Y 36 NY, 342 Mad Ave, Julian J Tunno ..... YU 6-6357
Tulsa Okla, 604 Mayo Bldg, Bryan A Ross ..... LU 3-2486

Claud S Gordon Company
Chi 16 Ill, 3000 S Wallace St, Claud S Gordon, Pres ..... VI 2-6525
Vincent Manke, Sales Mgr
Atlanta 5 Ga, 3240 Peachtree Rd NE, Control Equip Co ..... CE 3-1662
Baton Rouge La, Box 2905 Istrouma Sta, Gay Sales Co ..... EL 7-2423
Birm 9 Ala, 1929 Shades Crest Rd (Vestavia) Control Eq ..... TR 9-8211
Cinn 2 O, 2436 Reading Rd, R L Dietz ..... PL 1-0454
Cleve 14 O, 2035 Hamilton Ave, E W Romig ..... TO 1-6871
Dallas Tex, Box 11186, Gay Sales Co, R L Springfield ..... DA 7-0421
Det 11 Mich, 2832 E Grand Blvd, S Stanton ..... TR 2-1837
Houston Tex, 420 Sul Ross, Gay Sales Co, O W Wittmer ..... JA 9-3479
Indpls 4 Ind, 31 E Georgia St, R L Dietz ..... ME 2-6220
Kenmore 23 (Buff) NY, 42 Gardenwood La, Geo Bowker BE-8376
L A 23 Cal, 1430 Grande Vista Ave, Pac Scient Co ..... AN 2-1123
Milw 4 Wis, 647 W Va St, E C Ehlers ..... BR 1-1271
New Rochelle NY, Box 284, Claud A Gates Co ..... NE 2-1465
Phila 4 Pa, 3326 Lancastre Ave, Del Val Eng Co ..... EV 2-5952
Pgh 21 Pa, 789 Penn Ave, A Yeager ..... FR 1-2600
Port 14 Ore, 1218 SE 7th Ave, Pac Scient Co ..... BE 4-9747
St Louis 8 Mo, 4378 Lindell Blvd, K R Richtmeyer ..... FR 1-1611
San Fran 7 Cal, 25 Stillman St, Pac Scient Co ..... DO 2-0934
Seattle 8 Wash, 421 Mich St, Pac Scient Co MO-7000
Tulsa 3 Okla, 28 N Guthrie Ave, Paul King Co, H Hall ..... LU 4-3347
Wash Ga, Box 565, Control Equip Co, C Saunders 2451

Goslin-Birmingham Manufacturing Company
Birm 1 Ala, Box 631, J W Little, Pres ..... FA 4-7511
A B Adams, Sales Mgr Filter Div
H E Keene, Sales Mgr Evaporator Div
E V Hegg, Sales Mgr Process Equip Div
J I Joyner, Sales Mgr Contract Div

Graff Engineering Corporation
Dallas 6 Tex, 413 Meadows Bldg, R A Graff, Pres ..... EM 8-3760
Lucius Hannon Jr, Sales Mgr
John H Crow, Sales Mgr

Graham Manufacturing Company Incorporated
N Y 17 NY, 415 Lex Ave, F D Berkeley ..... MU 2-8770
W D Mains, Sales Mgr
Balt Md
Birm Ala
Boston Mass
Buff NY
Chi Ill
Cinn O
Cleve O
Coral Gables Fla
Denver Colo
Detroit Mich
Houston Tex
Kansas City Mo
L A Cal
Mobile Ala
Phila Pa
Pgh Pa
St Louis Mo
San Fran Cal
Seattle Wash
Tulsa Okla

Grover Construction Company Inc
N Y 17 NY, 424 Madison Ave, H C Pitcher, Genl Mgr ..... MU 8-6149
S D Barr, Genl Sales Mgr

Grover Tank and Manufacturing Company Incorporated
E Chi Ind, 4815 Tod Ave, J E Swanson, Pres 7-0204
H J D'Aragon, Gen Sales Mgr
D R Rhoades, Sales Mgr Eastern Div
W H Dwyer Jr, Sales Mgr Gulf Coast Div
J W Hafsten, Sales Mgr West Coast Div
J R O'Connor, Sales Mgr Cent Sales Div
Arcadia Cal, 1045 W Hunt Dr, J W Hafsten ..... RY 1-8978
Chi 4 Ill, 332 S Mich Ave, W C Behmer, Distr Sls Mgr ..... WA 2-8893
Det Mich, 2591 W Grand Blvd, J G Fleckenstein ..... TR 5-5300
E Chi Ind, 4809 Tod Ave, J R O'Connor EC-204
Houston Tex, 5343 McCormick, W H Dwyer Jr ..... WA 6-1763
Jenkintown Pa, The Benson (Phila) A I Webb, Dist Sls Mgr ..... LI 8-1105
N O 12 La, 1202 Richards Bldg, L H Gilmore, Distr Sls Mgr MA-5643
N Y 17 NY, 424 Mad Ave, D H Rhoades ..... MU 8-8181
Pgh 19 Pa, 330 Grant St, W F Wilt, Distr Sls Mgr ..... AT 1-3894
Sand Sprgs Okla, Box 546, J E Fogarty, VP ..... CI 5-1321
San Fran 4 Cal, 155 Mont St, J M Suardi, Distr Sls Mgr ..... GA 1-8948
Tulsa 3 Okla, 310 Thompson Bldg, E R Fogarty, D Sls Mgr ..... GI 7-4131

Graver Water Conditioning Company
N Y 11 NY, 216 W 14th St, H T Sutcar, Genl Mgr ..... WA 4-2321
V J Calise, Sales Mgr

Gould Pumps Incorporated
Seneca Falls NY, 300 Fall St, N J Gould, Pres 354
E E Backlund, Sales Mgr

A P Green Fire Brick Company
Mexico Mo, William S Lowe, Pres ..... JU 1-5000
James J Offutt, Sales Mgr

Green Fuel Economizer Company Inc The
Beacon NY, 627 Main St, Allan Davies, Pres 316
G V Eisermen, Sales Mgr

Grinnell Company Incorporated
Prov 1 RI, 260 W Exchange St, J D Fleming, Pres ..... TE 1-7000
C J Haugum, Sales Mgr Supply Div
D L Swats, Sales Mgr Fire Prot Div
Atlanta 2 Ga, 645 Northside Dr NW, C W Thrash ..... JA 4-6201
Billings Mont, 13 N 23rd St, J S Leland 9-4567
Buff NY, 1374 Clinton St, H J Meinhold FA-6111
Charlotte 8 NC, 1431 W Morehead St, V E Fuller ..... FR 6-4431
Chi 9 Ill, 4425 S Western Ave, G R Nicolai ..... VI 7-1500
Chillicothe O, 350 S Douglas Ave, T J Kelling ..... PR 4-3351
Cinn 29 O, 3253 Fredonia Ave, E P Wolford ..... UN 1-7772
Cleve 3 O, 1294 E 55th St, R J Riblet ..... HE 1-4311
Cranston 7 RI, 1341 Elmwood Ave, W R Hatfield ..... ST 1-9200
Dallas 2 Tex, 161 Glass St, J E Hatt ..... RI 8-3351
Denver 2 Colo, 2175 15th St, W G Dalziel ..... TA 5-7181
Fresno 1 Cal, 3081 Hamilton Ave, R L Olson ..... AM 8-5021
Houston 1 Tex, 1121 Rothwell St, A D Pace ..... CA 7-2263
K C 16 Mo, 2316 Burlington Ave, R W Smith ..... BA 1-3010
Long Beach 10 Cal, 1360 W Pac Coast Hwy, J S Tedford ..... HE 7-6417
L A 13 Cal, 520 Mateo St, K Kettman MU-5151
Milw 1 Wis, 1819 W St Paul Ave, J F Kaercher ..... WE 3-7040
Mpls 15 Minn, 623 Wash Ave S, H J Ruddy ..... FE 2-0321
N O 25 La, 7136 Wash Ave, L G Charbonneau GA-3125
N Y 22 NY, 400 Park Ave, E J Morris ..... PL 1-6700
Oakland 4 Cal, 6121 Hollis St, M K Murray ..... OL 2-7455
Phila 34 Pa, Erie Ave and D St, G J Robie ..... GA 5-5850
Pocatello Idaho, 650 S 1st Ave, R T Norman 1335
Port 10 Ore, 3240 NW 29th Ave, A D Dalziel ..... CA 3-7101
Sacramento 14 Cal, 615 7th St, C K Knudsen ..... GI 1-6901
St Louis 10 Mo, 1615 S Kingshwy, G H Peckham ..... PR 1-4925
San Fran 7 Cal, 601 Brannan St, G D Martin ..... GA 1-6700
San Jose 10 Cal, 50 Bellevue Ave, E F Thomas ..... CY 7-1260
Santa Barbara Cal, 305 E Haley St, R W Brown ..... WO 5-7027
Seattle 1 Wash, 3101 Elliott Ave, E J Nelsen MU-8440
Spokane 3 Wash, E909 Sprague Ave, H O Darnell ..... RI 7-6023

The Griscom-Russell Company
Massillon O, K B Ris ..... TE 2-7421
C D Steffens, Sales Mgr
Amarillo Tex, Amar Bldg, A M Lockett & Co ..... DR 2-9651
Atlanta Ga, 150 Nassau St NW, Rittelmeyer & Co ..... JA 4-1531
Baton Rouge La, 2987 Govt St, A M Lockett & Co ..... DI 4-7586
Boston 10 Mass, 10 High St, Farrell & Jones ..... HA 6-1759
Buff 26 NY, 17 Lincoln Rd, R S Brookman Assoc CI-3100
Cinn 2 O, 111 E 4th St, Henry Stroebl Jr ..... MA 1-1148
Cleve 15 O, 1836 Euclid Ave, H W Kaiser Co ..... CH 1-2863
Dallas 2 Tex, 1826 Life of Amer Bldg, A M Lockett & Co ..... RI 1-4155
Denver 4 Colo, 660 Bannock St, Stearns-Roger Mfg Co ..... AC 2-8484
Det 21 Mich, 17345 Wyoming Ave, Young C Smith & Co ..... UN 2-5096
El Paso Tex, Box 30, Stearns-Roger Mfg Co ..... KE 3-5501
Ft Worth Tex, 712 Ft Worth Natl Bk Bldg, C M Lockett ..... ED 6-2016
Greensboro NC, Box 2669, PO Stribling Jr BR-4-2445
Houston 25 Tex, 1100 E Holcombe Blvd, D C Corson ..... JA 3-7483
Indpls 4 Ind, 1211 Roosevelt Bldg, Geo A Wright ..... ME 5-1112
LaGrange Ill, 23 W Calendar Ave, F W Maier ..... FL 2-6294
L A 41 Cal, 2173 Colo Blvd Rm 215, J W Hagen ..... CL 5-1441
Mpls 3 Minn, 620 Plymouth Bldg, Geo R Mellema Co ..... FE 2-0528
Mission Kans, 203 Muntzel Keach Bldg, The Hesler Co ..... RA 2-6464
N O 7 La, 308 Whitney Bk Bldg, A M Lockett & Co CA-8382
N Y 17 N Y, 285 Mad Ave, H W R Wheeler ..... LE 2-3431
Phila 10 Pa, 1317 Land Title Bldg, R W Munro ..... RI 6-1880
Pgh 34 Pa, Box 10396, P C McKenzie Co ..... FI 1-9181
Port 22 Ore, 7800 SE McBrad Ave, Brad & McClung ..... OL 4-5401
Roch 18 NY, 2815 Monroe Ave, Arthur W Schuster Co ..... HI 5-4355
Salt L City 1 Utah, 40 Richards St, Stearns-Roger ..... DA 2-5891
San Fran 5 Cal, 55 New Mont St Rm 221, Glenn Barnaby ..... YU 6-0065
Schenectady NY, 171 Jay St, J E DeCook ..... FR 7-7011
Seattle 4 Wash, 241 Central Bldg, Fairman B Lee Co MU-1456
Shreve La, Box 1461, A M Lockett & Co ..... SH 5-5015
Tulsa 3 Okla, 716 Wright Bldg, R J Dunham Co ..... DI 3-8165

Gulberson Corporation, Division of Dresser Industries
Dallas 21 Tex, 1000 Forest Ave, Alex P Smith, Pres ..... HA 1-4101
Harry S Zane Jr, Gen Sales Mgr
Abilene Tex, 1450 S Treadway Blvd, J T Anderson ..... OR 3-2981
Alice Tex, Falfurrias Hwy 281, H H Harvey ..... MO 4-3292
Bakersfield Cal, 1725 Bernard St, E C Trott ..... FA 5-2627
Billings Mont, 1308 Colton, R W Lindsay Jr 2-4909
Carmi Ill, 509 Smith Dr, J G Cates 6516
Casper Wyo, 326 N Colo Ave, John E Johnston 2-6336
Corpus Christi Tex, W V Phillips ..... Mobile—WJ 5-5832
Dallas Tex, 1000 Forest Ave, Earl W Davis ..... HA 1-4101
Denver Colo, 3052 S Jasmine, L E Vessels ..... SK 6-0611
Duncan Okla, 1506 N 13th St, J P Killingsworth 2207
Farmington NM, 811 23rd St, C B Alexander ..... DA 5-5542
Gainesville Tex, 1005 Gladney, P L Brown ..... HO 5-5491
Great Bend Kans, 1214 Eisenhower, J L McHenry ..... GL 3-8481
Hobbs NM, 200 Permian Dr, D L Fry ..... EX 3-3672
Houma La, 800 Magnolia St, A E Brummett ..... UP 2-4183
Houston Tex, 1802 Maury St, W F Maier ..... CA 2-6174
Kilgore Tex, 406 E Turner St, D B Craver 3633
Lafayette La, Scott Rd, R L McAdams ..... CE 4-8536
Liberal Kans, 621 W Second, Jack B Haynes ..... MA 4-5825
L A Cal, 5563 E Sheila St, E E Embury ..... PA 1-1125
N O La, 613 N Pierce, Ray D Hicks ..... KE 4-5271
N Y 20 NY, 1270 Sixth Ave, Beckley, Haltom & Hickman ..... PL 7-3276
Odessa Tex, 1507 W 2nd St, L T Ferguson ..... FE 7-6613
Ojai Cal, Rt 1 Box 39, G L Stafford ..... MI 6-2643

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

to all NATURAL GASOLINE MEN

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from the

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We are looking forward to seeing you at the
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April 16-18, 1958, Baker and Adolphus Hotels, Dallas, Texas

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Smithco Engineering, Inc.
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Southwest Industries, Inc.
Sterns-Roger Mfg. Co.
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Walco Engineering & Constr. Co.
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Pampa Tex, 720 W Francis, Frank C Barritt ..... MO 4-2392
Ponca City Okla, 2112 Joe St, C W Green ..... RO 2-4611
Shreve La, 3802 Jackson St, Warren Ramsay 65-5456
Snyder Tex, 2312 40th St, D E Ritchie 3-3180
Victoria Tex, 3304 Meadow Lane, J R McManus ..... HI 3-4931
Wichita Falls Tex, 4815 Earl St, P P Kizis 767-3121
Williston N D, 823 3rd Ave E, L J Lipp 3-3837

H

D W Haering and Company Incorporated
San Antonio 4 Tex, Box 6037 Harlandale Sta ..... WA 2-1235
V W Haering, Pres
E H Snyder, Sales Mgr

Hagan Chemicals & Controls, Inc
Pgh 30 Pa, 323 Fourth Ave, W W Hopwood, Pres ..... CO 1-4722
John E Duesing, Sales Mgr

Hallikainen Instruments
Berkeley 10 Cal, 1341 7th St, K E Hallikainen, Pres ..... LA 4-1757
E F Schimbor
Chi 20 Ill, 1658 W 89th St, A Lauterbach
Houston 17 Tex, Box 12371, J K Farley
N Y 6 NY, 95 Liberty St, N Lieblich
Tulsa 4 Okla, Box 4095, James E Dyer
Van Nuys Cal, 14544 Archwood St, S R Brown

Hamer Valves Incorporated
Long Beach 6 Cal, 2919 Gardenia Ave, L S Hamer, Pres ..... GA 7-5491
Cleo Williamson, Sales Mgr
Buff 7 NY, 1807 Elmwood Ave, Robt H Parry Co ME-2318
Casper Wyo, 544 N Beverly, Rocky Mtn Rental Tool & Serv ..... CA 2-0571
Chi 30 Ill, 4335 W Peterson Ave, Maher Engrg Co ..... PE 6-8747
Cinn 3 O, N-204 Union Term Bldg, Plant Equip Co ..... PA 1-6183
Cleve 14 O, 1743 Chester Ave, NW Calvert Co ..... TO 1-2675
Corpus Christi Tex, Box 4074, Corpus Chr Gasket & Pkg Co ..... TU 4-6366
Det 21 Mich, 16522 Jas Couzens Hwy, Dale L Prentice Co ..... DI 1-0040
Havertown Pa, 511 W Chester Pike, Shelby Jones Co ..... HI 6-6610
Houston 4 Tex, 4101 San Jacinto St, R H Stockton Co ..... JA 4-9255
Mobile Ala, O'Gwynn Bldg, Bruckmann & Co ..... HE 3-8886
Needham 92 Mass, 1000 Gr Plain Ave, Stewart Miller ..... GA 1-5892
N O La, 504 Delta Bldg, F Carl Hoffman RA-2032
N Y 19 NY, 10 Col Circle Rm 1310, R J Eiche & Assoc Inc ..... CI 6-0970
Oakland 11 Cal, 4390 Piedmont Ave, Ben W Brundage Co ..... PI 5-3297
Okla City Okla, 902 SE 29th St, Tom S Andrews ..... ME 7-5150
Pgh 19 Pa, 311 Ross St, Bradshaw and Co ..... CO 1-2627
Port Ore, 4023 N Interstate, Henry Kalz ..... AT 7-9700
Rich Va, 207 N Laurel St, H M Summerell Co ..... MI 9-0559
Seattle 4 Wash, 539 1st Ave S, E C Griffin Co EL-4216
St Louis 20 Mo, 6110 Garesche Ave, Carl F Gast Co ..... EV 3-0750
Ventura Cal, 182 W Ramona, Robinson Oil Tool Co ..... MI 3-4898
W Lake La, Box 7, Warren Engrg Sales Co ..... HE 9-8546

Hammarlund Manufacturing Company Incorporated
N Y 1 NY, 460 W 34th St, Lloyd Hammarlund, Pres ..... LO 5-1300
L C Menhes, Sales Mgr Eng Prods Divn
Representatives in Principal Cities

Hammel-Dahl, Division of General Controls Company
Prov 5 RI, Warwick Ind Pk, Edw T Dahl, Pres ..... ST 1-6200
John R Curran, VP-Sales
L A 22 Cal, 5012 E Wash Blvd, Thos H Ponton ..... AN 2-8970
N Y 17 N Y, 12 E 41st St, Harold M Miller ..... MU 3-6729
Tulsa 3 Okla, 310 Thompson Bldg, Paul E Bowles ..... DI 3-3365
Wilm 1 Del, 1000 Wash St, John E Charsha Jr ..... OL 8-2301

Hammond Iron Works
Warren Pa, R Y Kopf, Pres 1150
R E Kramer, Sales Mgr
Arlington 9 Va, Box 9134 Rosslyn Sta, F D Johnson ..... JA 2-1299
Birm 8 Ala, Box 8641, Ensley Sta, P Matthews ..... ST 7-4631
Boston 10 Mass, 201 Devonshire St, T F Fitzgerald ..... HA 6-0790
Bridgeport 5 Conn, 140 Midland St, E F Trombley ..... ED 3-3581
Bristol Pa, 2nd & Del Aves, W S Cole ..... WI 5-0250
Casper Wyo, Box 479, R A Garling 2-1591
Chi 3 Ill, 105 W Adams St, F A Faville ..... CE 6-8860
Cinn 2 O, 901 St Paul Bldg, H Strobel Jr MA-1148
Denver 8 Colo, 1524 Spruce, L C Stephens ..... EA 2-2318
Greenville SC, Box 306, A N Stall 5-2686
L A 57 Cal, 2500 W 6th St, L Oberholtz ..... DU 8-1339
Newark 2 NJ, 744 Broad St, E H Bodinson ..... MA 3-6930
NYC — WO 2-3369
Orange Pk Fla, Holly Pt Rd, R S Radford ..... CO 4-9277
Pgh 19 Pa, 530 Sixth Ave, M G Walker ..... CO 1-6131
Provo Utah, Box 310, F J Meyers ..... FR 3-8150
S Weymouh Mass, Box 45, E J Gribbons ..... ED 5-1898
Warren Pa, Box 660, D C McGrath WA-1150

Handley-Brown Heater Company
Jackson Mich, 2101 Brooklyn Ave, H E Handley, Pres ..... ST 2-8227
H J Rust, Sales Mgr

Hanna Engineering Works
Chi 22 Ill, 1767 Elston Ave, J C Hanna, Pres ..... BR 8-2710
D L Shanks

Happy Company The
Tulsa Okla, 310 E 10th St, John E. Mahaffey, Pres ..... LU 5-9175
Leo C King, Sales Mgr
Ellinwood Kans, 416 E Santa Fe, Gordon Bristow 266
Ft Worth Tex, 804 N P Anderson Bldg, Ed Allan ..... ED 6-2614
Midland Tex, 4313 Mercedes Dr, Bill Halbert ..... OX 4-2395
Odessa Tex, 1307 W Second, Hugh D Brinson ..... FE 2-6417
Okla City Okla, 3708 NW 58th Terrace, H Ashworth ..... WI 6-2842
Salem Ill, Hwy 50 W, George Huff 487
Seminole Okla, 803 State St, Glenn Lail 392
Wichita Kans, 1537 N Sedgwick, E L Williams ..... WH 3-0561
Wichita Falls Tex, 2602 10th St, Ben E Shelton 723-1635

Harris Engineering Company
Dallas 2 Tex, 1214 Davis Bldg, J B Harris, Pres ..... RI 2-6096

Harshaw Chemical Company The
Cleve 6 O, 1945 E 97th St, C S Parks, Pres ..... RA 1-8300
R W Champion, VP-Sales
Chi 32 Ill, 4925 S Cal Ave, F L Hintze ..... RE 7-1008
Cinn 13 O, 6265 Wiehe Rd, A R Waters ..... RE 1-9100
Cleve 6 O, 1945 E 97th St, J O Jones ..... RA 1-8300
Det 38 Mich, 9240 Hubbell Ave, E A Steeger ..... VE 6-6300
Houston 11 Tex, 6622 Supply Row, L A Latour ..... WA 3-1627
L A 22 Cal, 3237 S Garfield Ave, G E Pfeger ..... RA 3-3161
Hastings-On-Hudson 6 NY, J E Spencer ..... HA 5-8250
NYC — LO 2-6250
Phila 48 Pa, Jackson & Swanson Sts, H B Webster ..... HO 2-4700
Pgh 22 Pa, 6th St & Ft Duq Blvd, R Brian ..... AT 1-7930

Harvey Aluminum
Torrance Cal, 19200 S Western Ave, Leo M Harvey, Pres ..... NE 6-2111
Atlanta 9 Ga, 1430 W Peachtree St NW Rm 607 ..... TR 5-8376
Berkeley Cal, 2020 Milvia St ..... TH 5-3133
Dallas Tex, 5044 N Westmoreland Rd ..... FL 7-4327
Det Mich, 16244 Jas Couzens Hwy ..... UN 4-1030
Oak Pk Ill, 6429 W North Ave ..... EU 3-0213
St Louis Mo, 2 Brentwood Blvd ..... VO 3-3445
San Diego 1 Cal, 2108 Fifth Ave ..... BE 9-0281
Seattle Wash, 550 Mercer St ..... AL -4991
Wash 6 D C, 1001 Conn Ave NW ..... RE 7-4366

Hartzell Propeller Fan Company, Div of Castle Hills Corporation
Piqua O, S Downing St, R N Hartzell, Pres 850
E C Englert, Sales Mgr
Atlanta Ga, 2110 Peachtree St NW, W B McBurney ..... EI -4436
Ballston Lake N Y, 2 Frank St, Wm L Jacobs ..... BHU 2-8378
Birm Ala, 544 Amer Life Bldg, Harry G Mouat ..... FA 2-3394
Buff N Y, 959 Kenmore Ave, E C Roseberry ..... BE -5600
Charleston W Va, 1206 Kanawha Blvd E, Jas R Mason ..... DI 4-4415
Charlotte N C, 2527 Dist St at Shuman Ave, W A Graham ..... ED 2-7716
Chattanooga Tenn, 2001 Broad St, Earl E Wright 5-3407
Chi Ill, 1249 Devon Ave, Richard Williamson ..... BR 4-2620
Cinn O, 1836 Dano Ave, Bryce Byard ..... JE 1-6664
Cleve O, 2012 W 25th St, A R Sautters ..... SU 1-5022
Dallas Tex, 303 Interurban Bldg, L C Eldridge ..... RI 8-2952
Dayton O, 120 Stonemill Rd, C E O'Brien ..... BA 4-8032
Denver Colo, 1201 E Colfax Ave, Don Bachman ..... KE 4-6915
Det Mich, 27320 Southfield Rd Lathrup Vill, C J Bush ..... EL 6-8233
Erie Pa, Box 254, W D Tribley ..... ER 2-6011
Fairfield Conn, 1243 Post Rd, Russell A Clapp Jr ..... CL 9-3349
Indpls Ind, 524 Merchants Bk Bldg, R A Hunter ..... ME 6-1478
Houston Tex, 5717 Kirby Dr, W T Leseman ..... JA 3-4565
K C Kans, 602 Minn Ave, Frank A Nail ..... DR 1-1580
Louisville Ky, Box 64, R L Craig ..... GL 8-2709
Memphis Tenn, 5447 Park Rd, Thos A Corum ..... MU 5-5024
Milw Wis, 1225 W Mitchell St, C J Katze-Miller ..... MI 5-7370
Mpls Minn, 620 Plymouth Bldg, Geo R Mellema ..... FE 2-0528
N O La, Box 779, W P Naser ..... RA -6243
N Y N Y, 1440 Broadway, G S Whiffen ..... PA 6-0277
Omaha Neb, 5101 Blondo St, Wm Freiden GL-3803
Orlando Fla, 1616 Bennet Rd, Jay Barton 5-5852
Pgh Pa, Bellevue Bk Bldg, W V O'Bryon ..... PO 6-8555
Rich Pa, 109 W Grace St, R C Tutwiler ..... MI 3-6207
Rock Is Ill, 3209 35th Ave, R D Carroll 6-7519
Salt L City U, 81 E 7th St, Walter R Fresne ..... EM 4-1136
Santa Clara Cal, Box 144, W C Florentine ..... CH 3-3217
Scranton Pa, 2126 Jeff Ave, Richard N Calman ..... DI 2-2805
Seattle Wash, 204 W Lucile St, Robt E Snyder ..... MO -9440
St Louis Mo, Box 4 Web Grs Sta, Jack T Dunstan ..... WO 1-7816
Syracuse N Y, 929 S Salina St, M N Blaine 75-5179
Toledo O, 2909 Detroit Ave, Chas Stockstiel ..... CH 4-5431
Torrance Cal, 2325 Torrance Blvd, Geo W Leseman ..... FA 8-2804
Tulsa Okla, 1437 S Main St, Jas E Dyer ..... CH 2-9376
Camden N J, 333 Arch St, Harold M Parent ..... WO 4-5256
Derby Kans, 343 Lakeview Dr, V A Spaulding ..... SU 8-0341

Haveg Corporation
Wilmington 8 Del, 900 Greenbank Rd, Dr John H Lux, Pres ..... WY 8-2271
J W Carrow, Sales Mgr

Haynes Stellite Company, Division of Union Carbide Corporation
Kokomo Ind, 725 S Lindsay Street ..... GL 2-5421
R M Briney, Pres (NYC) ..... MU 7-8000
R L Lerch, VP-Sales ..... GL 2-5421
C G Chisholm, Sales Mgr ..... GL 2-5421
Chi 2 Ill, 230 N Mich Ave, J A Gallaher ..... FI 6-3300
Cleve 14 O, 1300 Lakeside Ave, F P Shephard ..... MA 1-4204
Det 21 Mich, 10421 W 7 Mile Rd, D N Culver ..... DI 1-3131
Houston 11 Tex, 6119 Harrisburg Blvd, J W Thomson ..... WA 6-3165
L A 58 Cal, 2770 Leonis Blvd, F S Boericke ..... LU 3-3061
N Y 17 N Y,30 E 42nd St, E W Connolly ..... MU 7-8000
San Fran 6 Cal, 22 Battery St, F R Venton ..... YU 2-1360

Hays Corporation The
Mich City Ind, 742 E 8th St, Philip A Sprague, Pres ..... TR 2-5561
Harlan M Twible, Sales Mgr
Atlanta 6 Ga, 686 Greenwood Ave NE, Boiler Equip Serv ..... TR 6-3636
Balt 18 Md, 2127 Maryland Ave, Energy Cont Corp ..... BE 5-6926
Birm 9 Ala, 1806 Mayfair Dr, Heckeroth Eng Sales Co ..... TR 1-2866
Boston 10 Mass, 55 Batterymarch St, Control Instrs ..... HA 6-6416
Buff 7 N Y, 1807 Elmwood Ave, The Stone Co ..... DE -1873
Charleston 24 W Va, 709 Ruffner Ave, Engrg Prods Co ..... DI 3-9411
Chi 10 Ill, 444 N LaSalle St, Meters & Controls Inc ..... WH 4-1448
Cinn 37 O, 1720 Section Rd, Chapman Eng Sales o ..... EL 1-3140
Cleve 23 O, 22700 Shore Ctr Dr, Ilies Power Cont Co ..... RE 2-9300
Clinton Ia, 208 Johannes Bldg, Meters and Controls ..... CH 3-2033
Dallas 6 Tex, 4512 N Cent Expwy, Power Spec Co ..... TA 1-5149
Davenport Ia, 320 Western Ave, Deco Eng Prods 7-6123
Denver 5 Colo, 2124 Broadway, Joy & Cox Inc ..... AM 6-0323
Des Moines Ia, 1112 Locust St, Deco Eng Prods Co ..... AT 8-5721
Det 12 Mich, 7145 E Davison, Metrol Co ..... TW 3-6300
El Paso Tex, 2918 Madera St, Steel & Eng Prods Co 3-5521
Houston 6 Tex, 2000 Kipling St, Power Spec Co ..... JA 4-7421
Indpls 4 Ind, 115 N Penna St, DeHaven Eng Co ..... ME 2-2563
Kalamazoo Mich, 420 W South St, Metrol Co ..... FI 2-6097
K C 14 Mo, 7341 Broadway, Economy Equip Co ..... JA 3-1010
Knoxville Tenn, 412 E 5th Ave, Leinart Eng Co 5-0363
L A 16 Cal, 5137 W Jeff Blvd, Bushnell Cont & Equip ..... WE 6-2149
Manistee Mich, RFD #1, Box 164, Metrol Co 2089-J
Memphis 5 Tenn, 216 N Lauderdale Ave, C J Gaskell Co ..... JA 6-2241
Mich City Ind, E 8th St, Edward O Timm ..... TR 2-5561

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Milw Wis, 4385 N Green Bay Ave, Geo H Fredricks & Co ..... CO 4-1070
Mpls 2 Minn, 746 Builders Exch Bldg, Berry Ervin Eng ..... FE 2-8861
Newark 2 N J, 868 Broad St, Energy Cont Co Inc ..... MA 4-2585
N O 12 La, 400 Balter Bldg, Allan J Harris Co TU-9126
N Y 38 N Y,5 Beekman St, Energy Control Co ..... BA 7-0457
North Haven Conn, 31 State St, Energy Control Co ..... CE 9-2513
Oakland 11 Cal, 4168 Piedmont Ave, IMCO Equip Co ..... OL 5-6073
Phila 32 Pa, 3147 N Broad St, Energy Cont Corp ..... SA 2-7900
Pgh 19 Pa, 1014 Plaza Bldg, Jno D Hiles Co ..... AT 1-0145
Port 4 Ore, 320 S W Stark St, Bumstead-Woolford Co ..... CA 8-6686
Rich 19 Va, 615 E Franklin St, Berkness Cont & Equip 3-5357
Roch 9 N Y, 1038 Winston Rd N, The Stone Co ..... BU 8-2850
St Louis 8 Mo, 4526 Olive St, Economy Equip Co ..... FO 7-5328
Salt L City 1 Utah, 436 Atlas Bldg, Wm Z Harrison Co ..... EL 5-1242
Seattle 1 Wash, 1411 Fourth Ave, Bumstead-Woolford ..... EL -4915
Toledo 2 O, 2144 Mad Ave, Metrol Co ..... CH 1-2133
Tulsa 4 Okla, 1437 S Main St, Jas E Dyer Co ..... CH 2-9376
Wash 6 D C, 720 Mills Bldg, Meleney Eng Co ..... DI 7-6329
Wichita 7 Kans, 303 Pattie Ave, Economy Equip Co ..... AM 7-5155
Wilm 6 Del, 900A W 8th St, Energy Cont Corp ..... OL 8-4441
Worcester Mass, 4 Einhorn Rd, Control Instr Inc .....
Albany N Y, 1203 Central Ave, Energy Cont Co ..... AL 2-2938

Hazard Wire Rope Div, American Chain and Cable Co Inc
Wilkes-Barre Pa, 271 S Pa Ave, C N Johns Pres ..... VA 2-8191
E H Todd, Sales Mgr
Atlanta Ga, 1055 W Marietta St N W, N G Griffith ..... SY 4-8226
Chi 6 Ill, 400 W Madison St, G A Faerber ..... CE 6-9324
Denver 16 Colo, 4555 E 46th Ave, P D Steele ..... FR 7-8807
Houston 1 Tex, 630 McFarland St, H S Frady ..... WA 3-2661
N Y 17 N Y, 230 Park Ave, W W Runkle ..... MU 6-8800
Phila 22 Pa, 2nd and Diamond Sts, J J Rowley ..... RE 9-7460
Pgh 5 Pa, 2250 Noblestown Rd, W T Kyle ..... WA 2-2100
San Fran 7 Cal, 890 Tennessee St, G F Lehr ..... MI 7-4640

Heat-X Inc, Division of Dunham-Bush Incorporated
Brewster N Y, 1000 Mountain St, Cecil Boling, Pres
James A Mulcahey, Sales Mgr

Wyatt C Hedrick Engineering Corp
Houston 1 Tex, Box 1133, G MMcGranaham, Pres ..... JA 3-4451

Heil Process Equipment Corporation
Cleve 11 O, 12901 Elmwood Ave, C E Heil, Pres ..... CL 2-4141
R F Protiva, Sales Mgr Eastern Div
R I Peters, Sales Mgr Western Div
Birm 6 Ala, 5018 1st Ave N, D B Gooch ..... LY 2-8191
Buff 21 N Y, 100 Kimberly Rd, R Dale ..... PL -7111
Burlingame Cal, 1209 Burlingame Ave, W P Wooldridge ..... DI 2-0823
Charleston 23 W Va, Box 761, C Holtz ..... DI 3-7606
Chi 6 Ill, 400 W Mad, R Scheel ..... AN 3-2134
Cinn 11 O, 3311 Harrison Ave, A Betts ..... HU 1-7577
Clearwater Fla, Box 26, J Roney ..... CL 3-1136
Det Mich, 2970 W Grand Blvd, R Brown ..... TR 3-3992
Hingham Mass, 90 South St, L Thomas ..... HI 6-2650
Houston 19 Tex, Box 13291, M May ..... JA 2-0958
K C Mo, 638 W 39th St, F Moellers ..... LO 1-4660
N Y N Y, 152 W 42nd St ..... PE 6-1827
St Louis 2 Mo, 314 N Broadway, J O'Fallon ..... MA 1-2442
Salt L City 1 Utah, 526 W 8 South St, C E Sinclair 5-1162
Tulsa 3 Okla, 1011 Main St, D J Condit ..... LU 5-1209
Upper Darby Pa, Box 34, G Kelso ..... FL 2-1350

Helicoid Gage Division, American Chain and Cable Company
Bridgeport 2 Conn, C N Johns, Pres 5-0161
V E Lysaght, Sales Mgr

Helipot Corporation, Division of Beckman Instruments Inc
Newport Beach Cal, Don Duncan, Div Mgr ..... LI 8-0611
Karl Heller, Sales Mgr
Harry Schmidt, Sales Mgr Rotating Equip Dept
Ray Forbes, Product Line Sales Mgr Monitoring & Control Comp
Atlanta 5 Ga, 3133 Maple Dr NE, Bivins & Caldwell Inc ..... CE 3-7522
Baldwin N Y, 2270 Grand Ave, B B Taylor Co ..... BA 3-8000
Chi 18 Ill, 3347 W Irving Pk Rd, Roy J Magnuson ..... KE 9-7555
Cinn 37 O, Roselawn Ctr Bldg, Sheridan Associates ..... ME 1-2460
Cleve 29 O, 5348 Pearl Rd, Sheridan Associates ..... TU 4-8060
Dallas 6 Tex, 5622 Dyer St, Norvell Associates ..... FO 8-4180
Denver 4 Colo, 126 W 12th Ave, Allen I Williams Co ..... MA 3-0343
Det 35 Mich, 18222 Jas Couzens Hwy, Tiby Engrg Co** ..... UN 4-9298
Det 35 Mich, 15310 W McNichols Rd, S Sterling Co* ..... BR 3-2900
Ft Myers Fla, 35 W North Shore Ave, A H Lynch & Assoc* ..... FO 5-6762
Hamden Conn, 2345 Whitney Ave, Eltron Engrg Sales Co ..... AT 8-9276
High Point NC, 1923 N Main St, Bivins & Caldwell Inc ..... HI 2-6873
K C 30 Mo, 7916 Paseo Ave, Harris-Hanson Co ..... HI 4-9494
Moorestown NJ, 13 E Main St, Angus-Sloane Associates ..... BE 5-1900
Newtonville Mass, 246 Walnut St, Eltron Eng Sales Co ..... DE 2-6975
Redwood City Cal, 2015 El Camino Real, G S Marshall ..... EM 6-8214
Roch 10 N Y, 830 Linden Ave, E A Ossmann Corp ..... LU 6-4940
St Louis 17 Mo, 2814 S Brentwood Blvd, Harris-Hanson Co ..... MI 7-4350
St Paul Minn, 1359 W Maynard Dr, Roy J Magnuson ..... MI 6-7943
San Diego Cal, 3525 Fifth Ave, G S Marshall Co ..... CY 8-8234
San Marino Cal, 2065 Huntington Dr, G S Marshall Co ..... RY 1-6781
Seattle 4 Wash, Smith Tower, Samuel N Stroum Co ..... EA 3-6117
Syracuse N Y, 1204 South Ave, E A Ossmann Corp ..... GR 6-7073
Tucson Ariz, 3915 E Bwy, G S Marshall ..... EA 7-1501
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T A Warner, Sales Mgr
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H T Jones Jr, Sales Mgr
Atlanta Ga, Box 1308, Rittelmeyer & Co ..... JA 4-1531
Bellaire Tex, Box 175, Howard Hagood Co ..... GY 4-3511
Buff N Y, 421 Chamber of Comm Bldg, C H Love WA-7948
Cleve O, 1900 Euclid Bldg, R H Keene ..... CH 1-3580
Little Falls N J, Box 183, Geo Zeboro ..... AT 8-0270
L A 48 Cal, 136 N Orlando Ave, E J Brinkmeyer ..... WE 4-8347
Midland Tex, 2121 W Florida, Hy-Bon Engrg Co .....
N O La, Box 13063, Thompson Equip Co MA-3885
N Y NY, 150 Broadway, VATco Engrg Co, V A Tezzi ..... WO 2-7806
Oak Pk Ill, 1037 Wis Ave, E F Daly ..... EU 3-5109
Pensacola Fla, 631 Rue Max, Thompson Equip Co ..... HE 3-2916
St Louis 15 Mo, 153 Perthshire Rd, Carel Van Luin ..... PA 5-1234
San Fran Cal, 41 Sacramento St, C V Krause ..... SU 1-5758

Hercules Powder Company
Wilm 99 Del, Del Trust Bldg, Albert E Forster, Pres ..... OL 8-7211
Atlanta 3 Ga, 134 Peachtree St, W A Haines ..... JA 2-3201
Birm 3 Ala, 17 N 20th St, N R Downey ..... AL 2-0293
Boston 16 Mass, 200 Berkeley St, A H Sanford ..... LI 2-2842
Chi 4 Ill, 332 S Mich Ave, R J Bath ..... HA 7-5230
Cleve 14 O, 925 Euclid Ave, A E Gould ..... SU 1-4335
Dallas Tex, Fidelity Union Life Bldg, A C Gunter ..... RI 1-3418
Denver 15 Colo, 9635 W Colfax Ave, P A Ray ..... BE 7-5485
Det 2 Mich, 628 Fisher Bldg, R S Glover Jr ..... TR 2-1760
L A 5 Cal, 3460 Wilshire Blvd, J H Neal ..... DU 7-8151
N Y 17 N Y, 380 Mad Ave, L P Killilea ..... OX 7-0010
Raleigh N C, Cameron Bldg Cam Vill Sta, W H Burnside ..... TE 3-4413
St Louis 5 Mo, 111 S Bemiston Ave, P A O'Neill ..... PA 7-5571
San Fran 4 Cal, 120 Montgomery St, J H Neal ..... YU 6-2535
Wilm 99 Del, 9th & Market Sts, G B Ward Jr ..... OL 8-7211

Hewitt-Robins Incorporated
Stamford Conn, 666 Glenbrook Rd, Thos Robins Jr, Pres ..... DA 4-1151
F L Griffith, Sales Mgr Industrial Prods Div
Birm Ala, 3118 Third Ave S, Claud Andrews 4-8765
Boston 22 Mass, 69 Tenean St, F W Kayser ..... AV 2-5400
Charlotte 6 N C, 3601 Hutchinson Ave, C A Thompson ..... FR 7-2571
Chi 6 Ill, 402 W Randolph St, L C Holloman ..... DE 2-4570
Cleve 14 O, 314 Superior Ave NE, A J Ball ..... SU 1-8020
Ft Wash Pa, Ft Wash Ind Pk, J T Sheldon ..... MI 6-3900
Hibbing Minn, 718 E Howard St, C R Phillips ..... HI 3-9101
Houston Tex, 5711 Navigation Blvd, J W Pew ..... WA 6-3193
L A Cal, 2604 S Malt Ave, G V Migula ..... RA 3-4771
N Y 17 N Y, 370 Lex Ave, N M Godfrey ..... MU 6-2400
Pgh 19 Pa, 951 Union Trust Bldg, A. F. Mathey ..... AT 1-5548
St Louis Mo, 4030 Chouteau Ave, A S Purmort ..... JE 5-8240
Salt L City Utah, 545 W 8 South St, J E Van Stone ..... EL 9-8731
San Fran Cal, 1204 Russ Bldg, T E Zinter ..... EX 2-4060

Hilliard Corporation The
Elmira N Y, 209 W 4th St, T A Labrecque ..... EL 3-7121
T A Labrecque, Vice Pres Purifier Div
Atlanta Ga, 401 Volunteer Bldg, Frank O Walsh Jr ..... MU 8-5678
Balt 18 Md, 344 E 33rd St, Jobe & Co ..... BE 5-3503
Berkeley 2 Cal, 1501 San Pablo Ave, Jules D Gratiot ..... LA 4-4942
Boston 10 Mass, 113 Broad St, Gustavo Preston Co ..... HA 6-3995
Cinn 2 O, 307 E 4th St, R T Whitson & Sons ..... PA 1-1742
Cleve 18 O, 3091 Mayfield Rd, S L Powers Equip Co ..... FA 1-4025
Denver 2 Colo, 309 Cooper Bldg, Stiles Sales Co TA-1479
Det 2 Mich, 718 New Center Bldg, Korest-Peterson Co ..... TR 2-0551
Grayslake Ill, Box 358, E E Huff & Co Inc ..... HO 5-6700
Houston 1 Tex, 2330 Sul Ross, Lynn McGuffy Co ..... JA 8-5495
Jacksonville 5 Fla, 1609 Avondale Ave, J H Messerly ..... EV 8-8386
K C 13 Mo, 6315 Brookside Pl Rm 205, Sample Bros DE-2612
Kenmore 23 N Y, 75 S Irving Terr, Arch B Kirkwood RI-3054
Leonia N J, 252 Fort Lee Rd, Ember Products Inc ..... WI 4-7320
(NYC) — BA 7-4290
L A 31 Cal, 1101 Riverside Dr, Jules D Gratiot Co ..... CA 2-0125
N O 15 La, 1719 Toledano St, Betz Engrg Sales Co ..... TW 5-8691
Omaha 8 Neb, 1108 Farnam St, Schneider Elec & Equip WE-5550
Phila 19 Pa, 7116 McCallum St, The Pringle Co ..... CH 7-6843
Pgh 22 Pa, Bessemer Bldg, Bristol Metal Prod Co ..... GR 1-9988
Port 4 Ore, 429 SW 4th Ave, Benz Co ..... CA 8-3875
Rich 19 Va, 403 E Franklin St, C Arthur Weaver Co 2-6649
St Louis 17 Mo, 2010 Big Bend Blvd, Sample Bros ..... ST 1-7941
Salt L City 1 Utah, 526 W 8th South, Sales Engrg Co ..... EL 5-1162
Shreve La, 304 Sklar Bldg, Lynn McGuffy Co 5-3466
Spokane 1 Wash, 616 Hyde Bldg, General Equip Co ..... TE 8-1409
Tacoma 1 Wash, 2332 E 11th St, R E Chase & Co MA-4281
Tucson Ariz, 2323 Aviation Hwy, Cent Sta Equip Co 3-2493
Tulsa Okla, 1341 S Boston, J R Meek Co ..... LU 4-3304
Wash 6 D C, 720 Mills Bldg, Meleney Engrg Co ..... DI 7-6329

Hills-McCanna Company
Chi 30 Ill, 4613 W Touhy Ave, E A Hawe ..... OR 4-7080
Atlanta 5 Ga, 3230 Peachtree St, R Anderson ..... CE 3-5296
N Y 72 N Y, 76-11 37th Ave, E F Miller ..... DE 5-1102
Phila Pa, 69th & Market Sts, R E Lindquist ..... FL 2-2802

H & M Pipe Beveling Machine Company
Tulsa 20 Okla, 311 E Third St, M C Harter, Pres ..... DI 3-0241
Harry L Stallard, VP-Genl Mgr
Lloyd E Lippincott, VP-Sales

Hobart Brothers Company
Troy O, Hobart Sq, E A Hobart, Pres ..... FE 2-1223
E C Galbreath, Sales Mgr
D W Baker, Sales Mgr Motor Gen Corp Div

Hodag Chemical Corporation
Chi 45 Ill, 7247 N Cent Pk Ave, Sheldon E Kent, Pres ..... OR 5-3950
Robert R Mazer, Sales Mgr

Hoke Incorporated
Englewood N J, 136 S Dean St, Dr W O Teeters, Pres ..... LO 8-9100
E B Hitchcock, Sales Mgr
Arlington Hgts Ill, Box 128, Greg Moody Co ..... CL 5-3360
Baton Rouge La, Box 4587 Aud Sta, Moody-Price Inc 7-6416
Brookline 46 Mass, 233 Harvard St, Jas H Bertram & Co ..... BE 2-3212
Cinn 31 O, Box 75 Mt Healthy Sta, J R Douglass Co ..... WE 1-4986
Cleve 10 O, 902 E 140th St, Abbott Valve & Fitting Co ..... GL 1-4763
Col 24 O, 1834 Beaumont Rd, Moore Valve & Fitting Co ..... AM 7-5085
Denver 9 Colo, 1060 S Cook St, Jas B Drummond Co ..... SP 7-6748
Farmington Mich, Box 288 H E Lennon & Son ..... GR 4-6624
Greenville S C, 7 Clarendon Ave, Jas C White Co 5-7954
Havertown Pa, Box 514, Shelby Jones Co ..... HI 6-6600
Hopkins Minn, 86 Elmo Pk, Guy Speaker Co ..... WE 5-1144
Houston 1 Tex, Box 118, W H Curtin & Co ..... WA 3-1661
Indpls 20 Ind, 2013 E 65th St, L W Loyen Co ..... CL 1-8951
Jeffersonville Ind, 14 Allison Lane, J R Douglas Co ..... BU 2-1744
L A 54 Cal, 1363 S Bonnie Beach Pl, Braun Corp ..... AN 9-9311
Mountainside N J (NYC) 760 Mountain Ave, R S Crum & Co ..... WE 2-4445
Phoenix Ariz, Box 1431 Braun Corp ..... AL 8-1511

Advertisement in this issue, index is on page A-6.

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Pgh 34 Pa, 3737 Poplar Ave, Fogleman Co ..... LE 1-3249
Port 14 Ore, 619 SE Morrison St, Automation Products ..... BE 6-6457
Roch 10 N Y, 3 Juniper St, Carl A Pearson Co Inc ..... BU 8-2526
St Louis 17 Mo, 8030 Manchester Ave, The Zapff Co ..... ST 1-8580
Salt L City Utah, 650 W 8th St, Braun-Knecht-Heimann ..... EM 3-3961
San Fran 19 Cal, 1400 16th St, Braun-Knecht-Heimann ..... HE 1-8800
Seattle 99 Wash, 2800 15th Ave W, Automation Prods GA-7878
Spokane 2 Wash, N 120 Division St, Automation Prods ..... RI 7-2136
W Hartford 7 Conn, 998 Farmington Ave, Control Prods ..... AD 3-9823

Holmes & Narver Incorporated
L A 17 Cal, 828 S Figueroa St, James T Holmes, Pres TR-8201
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C B Roen, Mgr Petro-Chemical Div
K McBean, Mgr Nuclear Div

Homestead Valve Manufacturing Company
Coraopolis, Pa, Box 345, F E Schuchman, Pres ..... AM 4-3240
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Houdry Process Corporation
Phila 2 Pa, 1528 Walnut St, T A Burtis, Pres ..... PE 5-9490
R E Bland, Sales Mgr Process Div
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Howe-Baker Engineers Incorporated
Houston Tex, 503 Bk of Southwest, G B Hanson, Pres ..... FA 3-9126
R J Phillips, VP-Sales
Westwood N J, 35 Leonard Dr, Frank A Lee ..... WE 5-3063

Hudson Engineering Corporation
Houston 6 Tex, Box 6158, E J Hudson, Pres ..... JA 9-4261
Herman Urech, Cooling Equipt Sales

Hydrocarbon Research Incorporated
N Y 6 N Y, 115 Broadway, W J Norton, Vice Pres ..... DI 9-1480

Hynes Electric Heating Division, Turbine Equipment Company
Mountainside N J, 244 Sheffield St, G L Koester Jr, Pres ..... AD 2-5350
L A Mortenson, Sales Mgr
Albany Ga, 2110 Robin Hood Rd, C D Barclay ..... HE 6-5017
Albany N Y, 1A Lincoln Ave, Turbine Equip Co ..... UN 9-9862
Albuquerque N M, Box 456, Contractors' Equip & Sup 3-3565
Bethel Pk Pa, 37 Alton Dr (Pgh) R R Kovach ..... TE 5-6296
Billings Mont, Box 2537, Western Const Equip Co 9-5501
Boston Mass, 80 Federal St, Turbine Equip Co of NE ..... LI 2-5993
Buff 15 N Y, 3060 Bailey Ave, Turbine Equip Co WI-6237
Chi III, Fred I Johnson Co, Elmhurst ..... TE 2-8011
Denver Colo, 275 Kalamath St, Landes, Zachary & Peterson ..... MA 3-6203
Det 14 Mich, 9191 E Jeff, W E Lammers Co ..... VA 2-0228
Elmhurst III, 369 Montrose Ave, Fred I Johnson Co ..... TE 2-8011
Great Falls Mont, Box 1504, Western Const Equip Co ..... GL 3-1405
Houston Tex, 2518 Drexel Dr, Theger Co ..... MO 7-0081
K C 14 Mo, 7341 Broadway, Economy Equip Co ..... JA 3-1010
L A Cal, 213 E Valley Blvd, Heat Engrg & Supply Co, San Gabriel Cal ..... AT 7-9791
Millbrae Cal, 201 E Millbrae Ave, De Laval Pac Co ..... OX 7-4001
New Britain Pa (Phila) A Read ..... FI 8-2215
N Y 7 N Y, 63 Vesey St, Turbine Equip Co ..... WO 4-0666
Phila Pa, (New Britain Pa) A Read ..... FI 8-2215
Pgh Pa, (Bethel Pk) 37 Alton Dr, R R Kovach ..... TE 5-6296
Orlando Fla, Box 203 (Winter Pk) R L Smith 3-5322
Rapid City S D, J D Evans Equip Co RC-6
St Louis 8 Mo, 4526 Olive St, Economy Equip Co ..... FO 7-5328
San Fran Cal, 201 E Millbrae Ave, De Laval Pac Co, Millbrae Cal ..... OX 7-4001
San Gabriel Cal, 213 E Valley Blvd, Heat Eng & Supp ..... AT 7-9791
Seattle Wash, 535 First Ave W, DeLaval Pac Co SE-2800
Wash 6 D C, 1627 K St NW, Commercial Engrg Co ..... NA 8-9238
Westport Conn, Dooleytown Rd, Turbine Equip Co ..... CA 7-6654
Winter Pk Fla, Box 203, R L Smith ..... PA 3-5322

Hyster Company
Port 8 Ore, 2902 NE Clackamas St, E G Swigert, Pres ..... AT 8-5011
R F Moody, Sales Mgr Ind Truck Div
R M Ronald, Sales Mgr Tractor Equip Div
H A Raasch, Export Sales Mgr
Representatives in Principal Cities

I

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C H Benson, VP-Distributor Sales
J T Greenlee, VP-O E M Sales Div

Indikon Company Incorporated The
Watertown 72 Mass, 76 Coolidge Hill Rd, H Ginns, Pres ..... WA 4-2198
Houston 17 Tex, 8419 Hansen Rd, John L Shaunty ..... HU 4-1110

Industrial Crane and Hoist, Division of Ingersoll Products, Borg-Warner Corporation
Chi 8 III, 1536 S Paulina St, Keith N Stought, Plt Mgr ..... MO 6-1350
R T Gustafson, Sales Mgr
Birm Ala, Rm 208 Towne House, J L Billmeier 53-1669
Bloomfield N J, 600 Bloomfield Ave, M A Bravette ..... PI 8-0011
Detroit Mich, 23914 Grd River, L W Bentley ..... UN 4-5146

Industrial Filter and Pump Manufacturing Company
Cicero 50 III, 5900 W Ogden Ave ..... BI 2-1180
R E Liedborg, Exec Vice Pres
James F Zievers, Sales Mgr
Atlanta Ga, 415 E Paces Ferry Rd, W D Taulman ..... CE 7-0311
Balt Md, 12 W 22nd St, T E Byerly ..... HO 7-2926
Birm Mich, 19021 Hillcrest Blvd, Carl Beers ..... MI 6-5933
Buff 18 N Y, 1245 McKinley Pkwy, Forster-Johnston FA-2685
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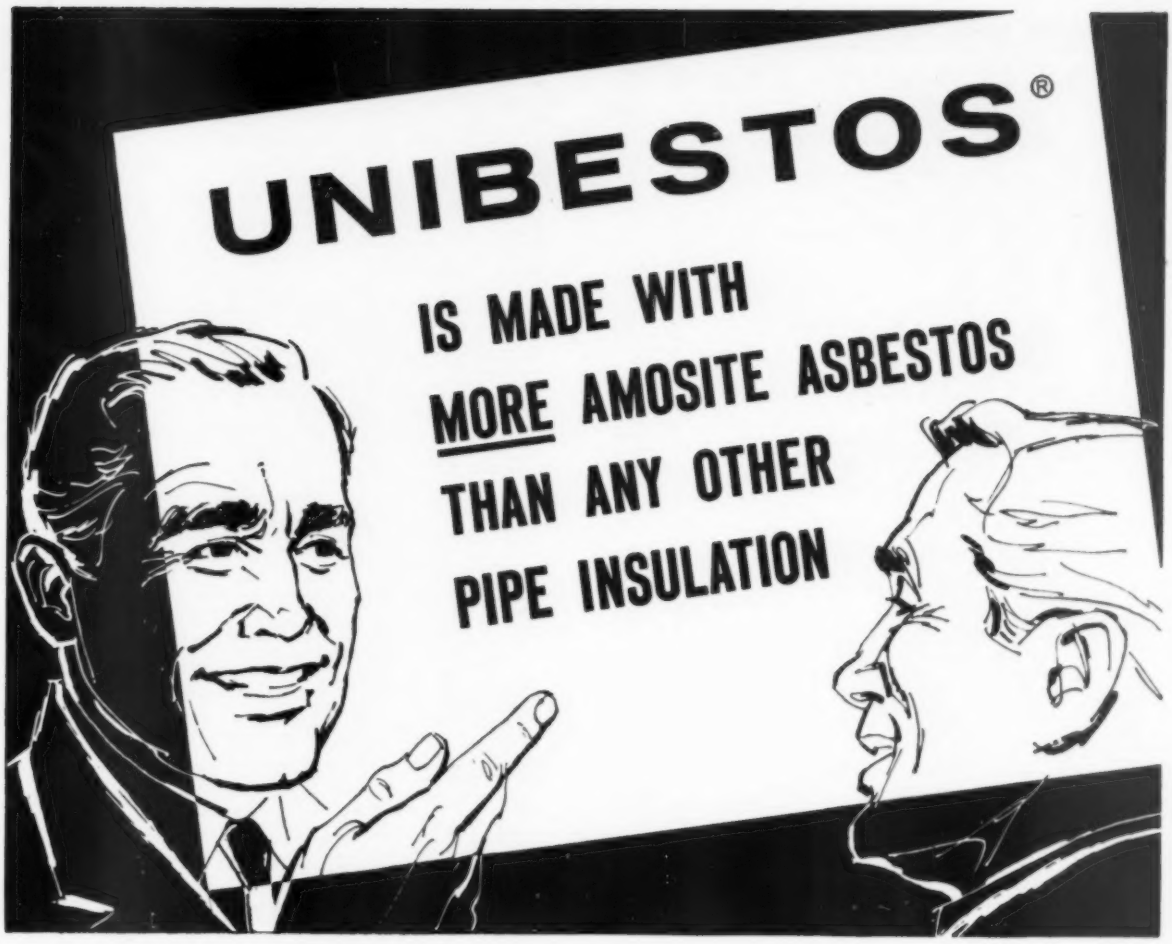

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N Y 17 N Y, 342 Mad Ave, J Arthur Moore Co ..... MU 2-2420
Oakind 11 Cal, 1980 Mountain Blvd, IMCO Equip Co ..... OL 5-6073
Odessa Tex, 2216 E 8th St, Daniel Orifice Fitting Co ..... FE 2-6473
Phila 40 Pa, 3701 N Broad St, Wm J Gallagher Co ..... BA 9-9940
Pgh 19 Pa, 501 Alcoa Bldg, D D Foster Co ..... AT 1-0865
Pompano Beach Fla, 330 SE 15th Ave, K L Diller & Assoc 3-3781
Port 4 Ore, 320 SW Stark St, Bumstead-Woolford AT-6686
Rich Va, 300 E Main St, W H Kidd & Co ..... RI 2-9240
St Louis 3 Mo, 2832 Olive St, O'Brien Equip Co JE-2091
Seattle 1 Wash, 1411 Fourth Ave, Bumstead-Woolford EL-4915
Tulsa 3 Okla, 801 Kennedy Bldg, W D Emery Co ..... DI 3-7624

Jo-Bell Products Incorporated
Oak Lawn Ill, 5456 W 111th St, Joseph Campanella, Pres ..... GA 5-0240
P J Bell, Sales Mgr
Balt Md, 103 E 25th St, George Goodman BE-5570
Buff N Y, 1807 Elmwood Ave, Robert Kerr BE-3882
Charlotte N C, Box 6091, Robert Hudgins 3-8446
Chi 5 Ill, 542 S Dearborn St, Wm Ferguson ..... WA 2-1808
Houston Tex, 420 Sul Ross St, Mr. Springfield ..... JA 9-3479
Cinn O, 3311 Harrison Ave, A A Betts ..... HU 1-7577
Dallas Tex, 2522 Carlisle, R F White ..... RI 2-3603
Det Mich, 17131 Hayden Ave, H Thompson ..... KE 1-3170
Denver Colo, 504 Mining Exch Bldg, C Davis ..... AL 5-3418
Jenkintown Pa, 201 Leedom St, Mr Deameley ..... TU 7-2010
K C Mo, 1735 Locust, Kirk Campbell ..... VI 2-2315
Long Beach Cal, 3815 Atlantic Blvd, Fred P Koenig
L A Cal, 333 Glendale Blvd, R S Dawson ..... DU 5-1471
Milw Wis, 5531 W North Ave, D E Riley ..... UP 1-9570
Needham Mass, 1241 Highland Ave, W B Parsons ..... NE 3-4870
N O La, 3144 Paris Ave, J P Maguire EV-2392
Oil City Pa, 2-A Natl Transit Bldg, Hugh Dorworth 47-334
San Fran Cal, 429 Bryant St, Jensen ..... EX 2-1472
Tulsa Okla, 28 N Guthrie, Paul King ..... LU 4-3347
Union City N J, 700 N Y Ave, C C Phelps ..... BA 7-1822

John-Lawrence Associates
N Y 18 N Y, 36 W 40th St, Lawrence Lowy, Ptnr ..... LO 4-8730

Johns-Manville Corporation
N Y 16 N Y, 22 E 40th St, A R Fisher, Pres ..... LE 2-7600
W R Wilkinson, VP-Sales
J A O'Brien, VP-Ind Prods Divs
D L Hinman, Mgr Ind Insulations Div
C B Burnett, Mgr Packings, Tex & Friction Mtls Div
R F Orth, Mgr Pipe Div
Atlanta 3 Ga, 101 Marietta St AL-8820
Boston 16 Mass, 100 Newbury St ..... CO 7-6500
Chi 54 Ill, Mdse Mart Plaza ..... DE 7-1144
Cinn 2 O, 510 Amer Bldg ..... PA 1-5840
Cleve 15 O, 45 Prospect Ave NW ..... MA 1-5151
Denver 2 Colo, 1755 Glenarm Place ..... KE 4-6378
Houston 4 Tex, 3115 Blodgett St ..... JA 6-1751
L A 5 Cal, 611 S Catalina St ..... DU 5-0595
Milw 9 Wis, 4260 N Teutonia Ave ..... UP 3-9220
N O 19 La, 2400 Canal St TU-0361
N Y 16 N Y, 270 Mad Ave ..... LE 2-7600
Phila 6 Pa, Chestnut St at 4th ..... WA 2-5000
Pgh 19 Pa, 2228 Koppers Bldg ..... AT 1-4040
St Louis 5 Mo, 7912 Bonhomme Ave, Clayton ..... PA 1-4000
San Fran 5 Cal, 116 New Montgomery St ..... DO 2-4353
Seattle 9 Wash, 777 Thomas St EL-8070

Johnson Gear and Manufacturing Company Limited
Berkeley 10 Cal, 8th & Parker Sts ..... TH 5-7376
G M Pamphilon, Chief Eng

Johnston and Jennings Company The, Division of Pettibone Mulliken Corporation
Chi 51 Ill, 4700 W Div St ..... SP 2-9300
Geo L Fox, VP-Genl Mgr
Beaumont Tex, 1650 Brockman St, Arthur Dooley 5-4549
Birm Ala, 1822 Huntsville Rd, G Johnson 3-2419
Boston Mass, 108 E Dedham St, Geo Kerisher ..... NO 2-1050
Cleve O, 6917 Bessemer Ave, G L Fox ..... MI 1-6924
Narberth Pa, Box 57, A L Diederich ..... MO 4-2455
N Y NY, 350 Fifth Ave, C G Van Cleve ..... BY 9-8600
Pgh Pa, 501 Alcoa Bldg, D D Foster ..... AT 1-0865
San Fran Cal, 900 Mills Bldg, Robt Borland ..... GA 1-1416
Tulsa Okla, 2445 S Jackson, Allan Edwards ..... DI 3-7184

Johnston Pump Company, Division of The Youngstown Sheet and Tube Company
Pasadena Cal, 3272 E Foothill Blvd ..... SY 5-8484
A H Miller, Vice-Pres - Genl Mgr
J R Mapel, Genl Sales Mgr
Chi Ill, 1225 Harlem Ave (Forest Pk) F E Higgins ..... FO 6-1850
Hastings Neb, 415 E G St, R L Triplett 3-1545
Houston Tex, Box 1289, M S Meyer ..... MI 5-3361
N Y NY, 205 E 42nd St, A D Apgar ..... MU 4-7021
Port 1 Ore, 4001 SW Jerald Ct, R E Boehm ..... CA 8-1215
Raleigh N C, 1048 S Saunders Ave, R D Ferguson ..... TE 2-8285
Roswell N M, 2007 SE Main, Fred LaTurner ..... MA 2-5942

Jones and Laughlin Steel Corporation
Pgh 30 Pa, 3 Gateway Ctr, Avery C Adams, Pres ..... CO 1-7400
J E Timberlake, VP-Sales
H E Robinson, Genl Mgr Product Div
C M Merritt, Genl Sales Mgr
E A Booth, Mgr Tubular Product Div
Atlanta 3 Ga, Fulton Fed Bldg, R R Garrison ..... JA 2-6805
Balt 2 Md, Mathieson Bldg, H R Dorney MU-5688
Boston 10 Mass, 10 High St, F B Kittredge ..... HU 2-5151
Buff 2 N Y, Lib Bk Bldg, R L Pierce WA-0268
Chi 3 Ill, Field Bldg, I A Mlodoch/R B Clark ..... FR 2-1764
Cinn 2 O, Carew Tower, W F Donaldson ..... MA 1-2323
Cleve 14 O, Union Comm Bldg, C M Kuhns/E R Nelson ..... MA 1-7866
Col 15 O, LeVeque Lincoln Tower, A C Pollock Jr ..... CA 1-5388
Dallas 1 Tex, Rep Natl Bk Bldg, H L Tomb ..... RI 8-4551
Denver 16 Colo, 4975 Colo Blvd, E A Toothaker ..... DU 8-2416
Det 2 Mich, Fisher Bldg, W K Breeze/R M Laning ..... TR 5-1600
Houston 2 Tex, Tex Natl Bk Bldg, D M Griffith ..... CA 2-0331
Indpls 4 Ind, Circle Tower Bldg, G G Marshall ..... ME 4-3413
K C 15 Kans, Funston & Chrysler Rds, C A Kral Jr ..... FA 1-1212
L A 58 Cal, 4727 E 48th St, R G Shearer ..... LU 7-7232
Louisville 2 Ky, Heyburn Bldg, F A Haynes ..... JU 5-3107
Memphis 3 Tenn, Edway Bldg, E E Hoehle ..... JA 5-7526
Mpls 2 Minn, Foshay Tower, B J Erwin ..... FE 9-8158
New Haven 10 Conn, Union & N H Trust Bldg, A S Lambie ..... UN 5-4120
N O La, Delta Bldg, T M Hogan ..... RA 5-9112
N Y 17 N Y, 405 Lex Ave, J O'H Anderson/H M Knobloch ..... YU 6-6600
Phila 3 Pa, Suburban Sta Bldg, H B Spackman ..... RI 6-0750
Pgh 30 Pa, 3 Gateway Ctr, J E Pierce/W E Porter ..... CO 1-7400
St Louis 1 Mo, Ambassador Bldg, R G Carney ..... GA 1-4075
San Fran 4 Cal, Russ Bldg, J H Tice ..... EX 2-0266
Youngstown O, 45 S Montgomery St, R E Stillman ..... RI 6-6311
Wash 6 D C, 1625 K St NW, F A Chidsey ..... NA 8-4101

Jones and Laughlin Supply Division
Tulsa Okla, 1421 S Sheridan Rd, Rainey Elliott, Pres ..... TE 6-1671
W L Wolfe, VP-Sales
R J Woods Jr, Dir of Sales
W O Hardy, Mgr Gen Prods Sales
W O Kupper, Mgr Sales - Projects
J T Batchelor, Mgr Tubular Products Sales

Jordan Corporation
Cinn 13 O, 6013 Wiehe Rd, G B Richards, Exec VP ..... EL 1-1352
W G Wilkins, Sales Mgr Eastern Div
P H Coleman, Sales Mgr Western Div
Representatives in Principal Cities

Joy Manufacturing Company
Pgh 22 Pa, Oliver Bldg ..... GR 1-2140
Birm Ala, 601 N 10th St, E A Crandall ..... AL 1-9262
Boston 15 Mass, 88 Brookline Ave, J E Moody ..... CO 7-8383
Chi 6 Ill, 560 W Wash Blvd, J Y Richards ..... DE 2-4760
Cleve 11 O, 16141 Puritas Ave, H E Butters ..... CL 1-9444
Dallas 20 Tex, 7425 Hines Blvd, Darrell Smith ..... FL 7-3949
El Paso Tex, 1022 Wyoming St, J E Douglas ..... KE 3-2121
Knoxville 2 Tenn, 108 W Main Ave, F B Waddock 2-4121
L A 22 Cal, 5426 E Wash Blvd, T G Weir ..... RA 3-6305
N Y 6 N Y, 140 Cedar St, D L Archibald ..... CO 7-6545
Pgh 13 Pa, 4107 Sennott St, M C Kelley ..... MA 1-4661
Salt L City 4 Utah, 998 S 6th West St, W R Swiler ..... DA 2-0481
Wash 6 D C, 1741 K St NW, A J Lee ..... EX 3-6200

Justrite Manufacturing Company
Chi 14 Ill, 2061 N Southport Ave, C S Packer, Pres ..... DI 8-2114
J N Grimshaw, Sales Mgr
Representatives in Principal Cities

K

Kaighin & Hughes Incorporated
Toledo 1 O, Atlantic & Spencer Sts, L I Hughes, Pres WA-5671
Alfred Abboud, VP-Sales
Akron O, 1417 E Archwood Ave ..... PR 3-5124
Toledo O, 726 Stanton St, Engrg Div WA-5671

Kaiser Aluminum and Chemical Sales Incorporated, Division of Kaiser Aluminum and Chemical Corporation
Chi 11 Ill, 919 N Mich Ave, D A Rhoades, Genl Mgr ..... MO 4-6900
J W Watson, Genl Sales Mgr Ind Div
Akron O, First Natl Tower ..... BL 3-6105
Atlanta Ga, 55 Marietta St NW ..... JA 3-1903
Balt Md, 5017 York Rd ..... ID 5-0750
Birm Ala, 1206 20th St South ..... AL 2-5196
Boston 16 Mass, 20 Prov St ..... HA 6-7255
Buff 22 N Y, 257 Elmwood Ave EL-9050
Charlotte N C, 12 S Tryon St ..... FR 5-7359
Chi 1 Ill, 360 N Mich Ave ..... DE 2-5080

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

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Cleve 13 O, 55 Public Square ..... SU 1-3000
Col O, 21 E State St ..... CA 1-5539
Dallas 1 Tex, 1712 Commerce St ..... RI 7-1501
Davenport Ia, 220 Main St 3-8005
Dayton O, 349 W First St Bldg ..... BA 4-0317
Denver Colo, 655 Brdwy ..... AL 5-3459
Det 2 Mich, 1414 Fisher Bldg ..... TR 3-8000
Grd Rpds 2 Mich, Div Ave & Fountain St NE ..... GL 6-8601
Hempstead L I NY, 320 Fulton ..... IV 3-0100
Houston 2 Tex, 3400 Montrose Blvd ..... JA 3-5518
Indpls 4 Ind, 333 N Penna St ..... ME 4-8311
K C 11 Mo, 3101 Broadway ..... VA 1-3780
L A 17 Cal, 900 Wilshire Blvd ..... MA 6-4801
Louisville 2 Ky, 823 Commonwealth Bldg ..... JU 4-2114
Memphis Tenn, 3355 Poplar Ave ..... ME 33-7646
Miami Fla, 1400 NW 36th St ..... NE 3-3431
Milw 3 Wis, 1701 W Wis Ave ..... WE 3-5864
Mpls Minn, 3033 Excelsior Blvd ..... WA 7-8728
Newark N J, 744 Broad St ..... MA 4-6116
N O 12 La, 124 Camp St TU-4678
N Y NY, 300 Park Ave ..... PL 9-1100
Oakland 12 Cal, 360 22nd St ..... CR 1-2211
Omaha 31 Neb, 3514 Dodge St WE-7846
Phila Pa, 3 Penn Ctr Plaza Suite 2000 ..... LO 8-0634
Phoenix Ariz, 213 N First Ave ..... AL 3-4841
Pgh 22 Pa, 140 Stanwix St ..... EX 1-0280
Port 5 Ore, 1220 S West Morrison St ..... CA 8-2383
San Diego 3 Cal, 438 Olive St ..... CY 8-8211
Saginaw Mich, 124 S Jefferson ..... PL 5-0543
St Louis 5 Mo, 10 S Brentwood Blvd ..... VO 3-1100
Seattle 4 Wash, 910 Fifth EL-7821
S Bend 1 Ind, 108 N Main St ..... CE 3-9311
Spokane 1 Wash, W 601 Riverside TE-2704
Syracuse N Y, 615 W Genesee St ..... GR 4-6825
Toledo O, 1806 Mad Ave ..... CH 8-6246
Tulsa 1 Okla, 619 South Main ..... CH 2-9261
Wichita 2 Kans, 2602 E Central Ave ..... MU 4-1001
York Pa, 1771 E Market St ..... YO 2-6987
Youngstown 12 O, 4005 Hillman St ..... ST 8-2441

Kaiser Engineers, Division of Henry J Kaiser Company
Oakland 12 Cal, 1924 Broadway, Geo Havas, VP-Genl Mgr ..... CR 1-2211
R M Cornforth, Sales Mgr
Chi 3 Ill, 79 W Monroe St, B O Burke ..... FR 2-9696
L A 17 Cal, 727 W 7th St, R M Sanders TR-6031
N Y 22 N Y, 300 Park Ave, M Nicholls ..... PL 9-1100
Pgh 19 Pa, 330 Grant St, T F Smith ..... AT 1-7992
Wash 6 D C, 1625 Eye St NW, C F Calhoun ..... ST 3-1555

M W Kellogg Company The, Subsidiary of Pullman Incorporated
N Y 17 NY, 711 Third Ave, Warren L Smith, Pres ..... OX 7-5200
W G Alexson, Sales Mgr
M J Carnesale, Sales Mgr Eastern Div
W T McCay, Sales Mgr Southwestern Div
J T Dickinson, Sales Mgr Midwestern Div
W R Dunn, Sales Mgr Western Div
Houston 2 Tex, 453 Esperson Bldg, W T McCay ..... CA 8-6481
San Fran Cal, 1407 Russ Bldg, W R Dunn ..... YU 6-4979

C M Kemp Manufacturing Company The
Balt 2 Md, 405 E Oliver St, J C Kimpel, Pres ..... VE 7-1166
E J Funk Jr, Vice Pres
Representatives in Principal Cities

The Kendall Company
Boston 10 Mass, 140 Federal St, Richard R Higgins, Pres ..... HU 2-3030
John L McConchie, Sales Mgr

Kennametal Incorporated
Latrobe Pa, Lloyd Ave, Philip M McKenna, Pres ..... KE 7-3311
Bennett Burgoon Jr, Sales Mgr
Chi 50 Ill, 5830 W 26th St, Fred Hennig Jr ..... BI 2-2420
Cinn 37 O, 7620 Reinhold Dr, Roger M McCray ..... PO 1-1407
Indpls 8 Ind, 2445 N Meridian St, Frank W Hull ..... WA 5-6427
L A 58 Cal, 4585 Pac Blvd, George Dolan ..... LU 3-2191
Milw 3 Wis, 744 N Fourth St, R H Oberholtzer ..... BR 6-0768
Oak Park (Detroit) Mich, 10201 Cpital Ave, Thos Kniff ..... JO 6-3183
Phila 40 Pa, 3701 N Broad St, Geo E Smith ..... BA 9-3442
Pgh 19 Pa, Rm 802 600 Grant St, Jerome G Brady ..... AT 1-4543
Springfield 8 Mass, 758 Sumner Ave, Robt S Sagers ..... RE 4-1120
Willoughby (Cleve) O, 4610 Beidler Rd, Earle E Boyer ..... WH 2-8800

Kieley and Mueller Inc
Middletown N Y, 64 Genung St, Joseph O'Connor, Pres ..... Mf 2-2526
Norman Lieblich, VP - Sales Mgr

Kiemp Metal Grating Corporation
Chi 38 Ill, 6697 S Melvina Ave, Lee Shelley, Pres ..... PO 7-6760
Foster W Lamb, Sales Mgr

Kobe Incorporated
Huntington Pk Cal, 3040 E Slauson, C J Coberly, Pres ..... LU 8-1271
W F Slater, VP-Genl Sales Mgr
Ray Elner, Sales Mgr Hydraulic Div
P H Jamison, Sales Mgr Industrial Div
Bakersfield Cal, 219 Haberfelde Bldg, Ralph L Fanthus ..... FA 4-9366
Cleve 14 O, 815 Superior Ave, T C Ley ..... CH 1-5633
Ft Worth Tex, 1403 Continental Life Bldg, V L O'Neill ..... ED 2-5692
Houston 20 Tex, 5807 Harvey Wilson Dr, J T Lewis ..... WA 6-8681
Huntington Pk Cal, 3040 E Slauson, C P Brown ..... LU 8-1271
Midland Tex, 211 West Bldg, A R Tullos
Tulsa Okla, 406 Pan Amer Bldg, H W Wilson ..... CH 2-7772

✔ **Koch Engineering Company Incorporated**
Wichita Kans, 321 W Douglas Ave, Ranie H Love, Pres ..... AM 7-3325
Griffin C Thrift, Sales Mgr
Houston Tex, Alpha Engrg Co
N Y NY, 295 Mad Ave, Crawford Engrg Co
Park Ridge Ill, 1521 Courtland Ave, M B Fisher
Pasadena Cal, 774 E Green St, Jacobs Engrg Co
Pgh Pa, 501 Alcoa Bldg, D D Foster Co
Tulsa Okla, Wright Bldg, W C Myers Co

✔ **Koehring Division, Koehring Company**
Milw 16 Wis, 3026 W Concordia Ave, E A Brugger, Pres ..... UP 3-4500
J E Chadwick, Sales Mgr

Koppers Company Incorporated, Metal Products Division
Balt 3 Md, 200 Scott St, H B Cummings, Vice Pres ..... SA 7-2500
H P Neher Jr, Sales Mgr
Boston 16 Mass, 250 Stuart St, E Ralph Gibbs ..... HA 6-1700
Buff 2 N Y, 625 Del Ave, Zane B Laycock GA-9304
Cinn 36 O, 6900 Silverton Ave, E C Jex ..... TW 1-4031
Chi 3 Ill, 122 S Mich Ave, J E Onnen ..... WE 9-2400
Cleve 15 O, 1900 Euclid Ave, J N Moore Jr ..... MA 1-2034
Det 3 Mich, 301 W Eight Mile Rd, H J Blecki ..... FO 6-5200
Haverford (Phila) Pa, 355 Lancaster Ave, A F Brown ..... MI 2-5855
L A 5 Cal, 3450 Wilshire Blvd, E P Larned ..... DU 8-0676
N Y 22 NY, 430 Park Ave, R J Green ..... PL 5-2810
Pgh 19 Pa, 2320 Koppers Bldg, J E Meyers ..... EX 1-3300
San Fran 5 Cal, 55 New Mont St, J W Freund ..... DO 2-3364

✔ **Kraloy Plastic Pipe Company**
L A 22 Cal, 4720 E Wash Blvd, Robert C Raab, Pres ..... AN 1-4158

Kuljian Corporation The
Phila 21 Pa, 1200 N Broad St, Harry A Kuljian, Pres ..... ST 2-9000
Hilton A Levonian, VP-Sales

L

Laboratory Equipment Corporation
St Joseph Mich, Hilltop Rd, Carl E Schultz, Pres ..... YU 3-5534
H J Schmitt, Genl Sales Mgr

Laboratory Glass and Instruments Corporation
N Y 31 N Y, 514 W 147th St, Joseph Buchler, Pres ..... AD 4-2626

Ladish Company
Cudahy Wis, 5481 S Packard Ave, J F Hacker, Vice-Pres ..... HU 1-1500
R T Meek, Sales Mgr Fittings Div
Atlanta Ga, 1145 Peachtree St NE, R A Payne ..... TR 2-8855
Buff 3 N Y, 14 Lafayette Sq, J B Slater CL-6477
Chi 4 Ill, 332 S Mich Ave, J A Blaney ..... HA 7-3290
Cleve 15 O, 627 Hanna Bldg, H L Lawry ..... TO 1-0642
Denver Colo, 1700 Broadway, G E Mahoney ..... MA 3-5371
Houston 25 Tex, 1100 E Holcombe Blvd, J M Browning ..... JA 4-7557
L A 58 Cal, 3321 E Slauson Ave, H L Pehrson ..... LU 3-4681
N Y 17 N Y, 60 E 42nd St, W B Dickey ..... MU 2-7662
Phila 2 Pa, 1405 Locust St, T J Mandes ..... KI 5-5623
Pgh 19 Pa, 3020 Grant Bldg, J H Teague ..... GR 1-9516
St Louis 8 Mo, 3615 Olive St, W P Foley ..... JE 5-4175
St Paul 14 Minn, 2200 Univ Ave, H H Rugg ..... MI 5-3909
San Fran 11 Cal, 420 Market St, C B Jedin ..... YU 2-6360
Seattle 9 Wash, 314 Fairview Ave, W W Warren SE-0747
Tulsa Okla, 1810 S Balt, G H Loeffler ..... GI 7-7261

Hans L Landay-Scientific Glass Laboratory
Boulder Colo, 2870 Pearl St, Hans L Landay, Pres ..... HI 2-2141

Lapp Insulator Company Inc
LeRoy N Y, 40 Gilbert St, R L Jenner, Pres 385
Brent Mills, VP - Sales
L F Wilson, Mgr Process Equip Div

Lau Blower Company
Dayton 7 O, 2027 Home Ave, T I Byrd, Pres ..... AM 3-3591
Edw V Sullivan, Sales Mgr Fan Div
Wm W Morrisey, Sales Mgr Blower Div
Cinn 30 O, 6422 Glade Ave, Don G Jensen ..... BE 1-6408
Cleve 24 O, 1561 Woodrow Ave, Chas C Miley ..... HI 2-4388
Cranford N J, 11 English Vill, E C Wolford ..... BR 6-1017
Dearborn Mich, 9 Byfield Lane, J B Wallace ..... LU 2-3895
Denver 2 Colo, 1421 Court Pl, Ben T Clark ..... MA 3-2011
Elmwood Pk 35 Ill, 2047 77th Ave, Wm J Lohrey ..... GL 3-8462
K C 14 Mo, 8906 Holly Ave, Chas L Sigman ..... EM 3-0486
Pasadena 8 Cal, 495 Cliff Dr, G R Mergenthaler ..... SY 2-8679
Prairie Vill 15 Kans, 7112 Buena Vista, V Stewart ..... EN 2-2784
Seattle 55 Wash, 19246 Lago Pl, W M Peistrup EM-8075
Syracuse N Y, 560 Allen St, Henry Seebach ..... GR 2-1953
York Pa, 327 Lambeth Dr, E F Humphrey 3-4612

✔ **Layne & Bowler Incorporated**
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J G Gordon III, Sales Mgr
Albany Ga, Box 356, Layne Atlantic Co, John David
Ames Ia, Box 350, General Filter Co, J P Lawlor
Ames Ia, Box 662, Layne Western Co, F H Flores
Arlington Mass, Box 27, Layne N Y Co, G S Divins
Aurora Ill, 721 Ill Ave, Layne Western Co, R W Brooks
Camden N J, 431 Market St, Layne N Y Co, O C Lewis
Carlisle Ark, Box 173, Layne Arkansas Co, Everett Graves
Cleve Miss, Box 927, Layne Central Co, T E Arbogast
Col O, 1100 W Town St, Layne Ohio Co, John Harmon
Corpus Christi Tex, 4548 Baldwin Blvd, G R Hatchkiss
Dallas Tex, Box 11665, Layne Texas Co, Ray Taylor
Denver Colo, 4672 E Vassar Ave, Layne Western, P C Haswell
DeWitt Ark, Layne Ark Co, Genl Dely, James Bell
El Paso Tex, Box 3336, Layne Texas Co, R C Semple
Fair Oaks Ark, Box 258, Layne Ark Co, Bill Hix
Florence S C, Box 862, Layne Atlantic, A C Burnett
Glen Burnie Md, Box 185, Layne Atlantic, H A Gropp
Houston Tex, Box 9098, Layne Texas Co, O F Jensen
Indpls Ind, 227 W Edwards Ave, Layne Northern, John Proos
Jackson Miss, Box 2387, Layne Central Co, E W Hall
Jonesboro Ark, Box 205, Layne Ark Co, Calvin Hesse
K C Mo, 1010 W 39th St, Layne Western, R D Joslyn
Lake Chas La, Box 887, Layne La Co, F R Gibson
Lake Vill Ark, Box 526, Layne Ark Co, David Zimmerman
Lansing Mich, 2000 N Turner, Layne Northern Co, Ervin Stahl
Linden N J, Box 266, Layne N Y Co, W A North
Lubbock Tex, 4607 Ave H, C H Gelin
McGehee Ark, Box 217, Layne Ark Co, Chesley Peacock
Memphis Tenn, Box 6696, Layne Cent Co, T M Ragsdale
Milw Wis, 6005 W Martin Dr, Layne NW Co, E J Rogers
Mishawaka Ind, Box 299, Layne Northern Co, N E Gunderson
Monroe La, Box 1002, La Well Co, F J Scoggins
New Hyde Pk L I NY, Box 234, Layne N Y Co, F R Thaeder
Norfolk Va, Box 7095, Layne Atlantic Co, Paul Schweitzer
Omaha Neb, 4430 Comm, Layne Western Co, G H Beard
Orlando Fla, Box 5158, Layne Atlantic, J E Phillips
Pensacola Fla, 3720 N Palafox, Layne Atlantic, J L Snow

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Wichita Kans, 1011 W Harry St, Layne Western Co, D R Soder

Ledeen Manufacturing Company, Division of Ledeen Incorporated
El Monte Cal, 3350 N Gilman Rd, Hyman Ledeen, Pres ..... CU 3-3163
Harold Rosoff, Sales Mgr
Albuquerque N M, 3108 4th St NW, A E Boyd Equip Co 4-6016
Bakersfield Cal, 301 26th St, Hopper Mach Wks ..... BA 4-4991
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Charleston 22 W Va, 509 Unite! Carbon Bldg, Pyro-Neers .....
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Cleve 14 O, 1599 St Clair Ave, Tomlinson Steam Spec ..... PR 1-4108
Col S C, 823 Gervais St, Columbia Supp Co CO-5121
Dallas Tex, 324 Interurban Bldg, L C Eldridge Sales ST-2952
Denver 14 Colo, 1795 Sherman Blvd, Patten Engrg Co ..... BE 7-0433
Det 26 Mich, 1820 Dime Bldg, John V Moymes Co ..... WO 1-7780
El Paso Tex, 604 Montana St, Roger Brown Co ..... EL 2-5418
Eugene Ore, 44-51 7th Ave E, Amer Steel & Supp Co ..... EU 5-0373
Eureka Cal, Ft of S St, Eureka Boiler Wks ..... HI 3-1681
Houston Tex, 5717 Kirby Dr, L C Eldridge Sales Co ..... JA 3-4565
Indpls Ind, 648 E 54th St, Brosey Engrg Co ..... CL 3-2306
Jacksonville 4 Fla, 578 Nixon St, Holt Equip Corp ..... JA 7-4034
K C 9 Mo, 1733 Main, Allied Trans Equip Co ..... GR 1-5505
El Monte Cal, 3350 N Gilman, Engrg Prods Co ..... CU 3-3163
Medford Ore, 703 S Grape St, Amer Steel & Supp ..... ME 2-7181
Memphis 2 Tenn, 477 S Front St, Memphis Bearing ..... ME 8-7543
N O 12 La, 715 Camp St, Edwards Engrg Co TU-0175
N Y 38 N Y, 150 Broadway, Vatco Engrg Co ..... WO 2-7805
N Bend Ore, Box 824, Ind Steel & Supp Co ..... SK 9-2731
Oakland 10 Cal, 3664 Grand Ave, The Otrich Co ..... TE 2-3781
Phila Pa, Box 207 Narberth, Link Engrg Co ..... MO 4-4399
Phoenix Ariz, 610 S 19th Ave, Lee Redman Equip Co ..... AL 8-3794
Pgh 6 Pa, 5493 Penn Ave, Banks Engrg Co ..... MO 1-5453
Port 1 Ore, 10895 NW Cornell Rd, Portland Engrg Co ..... MI 4-2611
Reno Nev, 307 Merrill Ave, Sierra Machy Co ..... RE 2-6981
Roch 9 N Y, 175 Akron St, Siewert Equip Co CU-7224
Salt L City 1 Utah, 101 W 2nd South St, Nat'l Equip ..... EM 3-8878
Seattle 4 Wash, 1731 1s Ave S, Standard Equip Sales SE-1955
Spokane 31 Wash, E 3500 Riverside Ave, Genl Machy KE-1535
Tulsa Okla, Box 4095, Jas E Dyer Co ..... CH 2-9376
Wash 6 D C, 1612 Eye St NW, Jos C Soroghan & Assoc ST-3612
Worchester 2 Mass, 20 Manhattan Rd, W M Pike & Assoc ..... WO 4-0298

Leeds & Northrup Company
Phila 44 Pa, 4701 Stenton Ave, I Melville Stein ..... DA 9-4900
D E Moat, Mgr Marketing Dept
N Cohn, Mgr Market Dev Div
H L Scutt, Mgr Sales Engrg Div
Atlanta 5 Ga, 3084 Grandview Ave NE, W S Bloor ..... CE 7-8624
Balt Md, 311 E Penna Ave (Towson 4), J C Emerline ..... VA 5-7710
Boston 66 Mass, 430 Lex St (Auburndale) E D Moiles Jr ..... LA 7-9360
Buff 2 N Y, 374 Del Ave, W L Kimber WA-7823
Chi 1 Ill, 307 N Mich Ave, E A Yeo Jr ..... CE 6-3428
Cinn 36 O, 8005 Plainfield Rd, M S Nolen ..... SY 1-2274
Cleve 6 O, 1922 E 107th St, W A Macan III ..... SW 1-5100
Col 15 O, 81 E State St, C W Sullivan ..... CA 4-7677
Denver 2 Colo, 1545 Glenarm Pl, W A Gneiser ..... AC 2-1808
Det 35 Mich, 18240 Jas Couzens Hwy, F D Burnett ..... DI 1-2320
Hartford 8 (West) Conn, 10 N Main St, H J Nethery ..... AD 2-4474
Houston 6 Tex, 3939 Essex Lane, R E Hansen ..... MO 7-7481
Indpls 18 Ind, 3513 N Hovey St, E E Tuttle ..... WA 6-2462
K C 14 Mo, 7935-Al State Line Rd, T E Bradley ..... JA 3-8199
L A 22 Cal, 5111 Via Corona Ave, G F Rucker ..... AN 9-3191
Milw 2 Wis, 828 N Broadway, W D Trueblood Jr ..... BR 2-1016
N Y 17 N Y, 711 Third Ave, P K Welch ..... MU 7-4133
Phila (Ft Wash) Pa, J M Jackson ..... MI 6-5500
Pgh 34 Pa, 300 Mt Lebanon Blvd, W H Neu ..... LO 1-7808
St Louis 5 Mo, 8000 Bonhomme Ave, Clayton, J F Sneath ..... PA 6-0853
Salt L City 11, 455 E 4th St, J E Reed ..... DA 8-8861
San Fran 3 Cal, 1095 Market St, P H Dtizler ..... MA 1-3464
Seattle 9 Wash, 1311 Republican St, S B Biddle Jr EL-5505
Tulsa 3 Okla, B E 4th St, M E Griffith ..... GI 7-3720

Lenape Hydraulic Pressing and Forging Company
West Chester Pa, Box 536, C H Moore, Pres ..... SW 3-1500
R M Hanny, Sales Mgr
Arcadia (LA) Cal, 1045 W Hungington Dr, P Glenn Smith ..... HI 6-4497
Birm 3 Ala, 1819 28th Ave S, C I Crais Co ..... TR 9-4673
Chi 17 Ill, 5903 W Chi Ave, A E Rasmussen ..... MA 6-2146
Cleve 18 O, 3473 Fairmont Blvd, Billington Metal Sls ..... YE 2-8270
Det 2 Mich, 427 New Center Bldg, F L Uhas & Co ..... TR 2-3443
Houston 1 Tex, 3611 Clinton Dr, Maintenance Engrg ..... CA 7-3135
K C 10 Mo, Box 558, Mid States Supp Co ..... VI 2-4290
L A 10 Cal, 5125 Sante Fe Ave, Howard Supp Co KI-1281
Milw 8 Wis, 1348 N 37th St, A E Rasmussen ..... DI 2-2066
N Y 7 N Y, 53 Park Pl, Astubeco Inc ..... BE 3-9130
Oakland 7 Cal, 230 Mad St, Howard Supp Co ..... GL 1-0770
Okla City 2 Okla, 120 E Main St, Federal Corp ..... FO 5-7301
Omaha Neb, 1346 S 20th St, Midco Supp Co HA-2226
Pgh 19 Pa, 1718 Grant Bldg, Herbert P Smith Co ..... AT 1-8848
Rich 1 Va, 801 E Cary St, John H Frischkorn Jr Inc 2-5848
St Louis 15 Mo, Red Bud & Bulwer Aves, Flori Pipe Co ..... EV 1-3800
San Fran (Berkeley) Cal, 1321 7th St, D P Downing ..... SU 1-8399
Seattle Wash, 33 Taylor Ave Bldg, Jas T Hansen Co AD-8101
Tulsa 3 Okla, 303 S Frankfort, Ardun Supp Co ..... LU 7-2405
Tulsa 3 Okla, 6310 E 13th St, Tyler-Dawson Supp Co ..... TE 5-7601

Le Roi Division, Westinghouse Air Brake Company
Milw 1 Wis, P I Birchard, VP ..... GR 6-2600
J E Heuser Genl Sales Mgr

Leslie Company
Lyndhurst N J, John S Leslie, Pres ..... GE 8-8000
Russell W Boettiger, Dir of Sales
Roy D Kelly, Sales Mgr Southeastern Div
A J Dromm, Sales Mgr Midwestern Div
H A Frederick, Sales Mgr
J E Bermingham, Sales Mgr Northeastern Div
R B Stockdale, Sales Mgr Southwestern Div
J S Martin, Sales Mgr Western Div

Lewis-Mathes Company, Division of Cerro de Pasco Corporation
St Louis 2 Mo, 1111 Chouteau Ave, F S Dreyer, Pres ..... CH 1-1975
Rodrick J Lewin, Dir of Sales
Jerry Marx, Mgr Mill Product Sales
Roy C Klostermeyer, Mgr Distributor Sales
Atlanta Ga, 76 4th St NW, J T Greer ..... TR 5-8504
Boston Mass, 729 Boylston St ..... CO 7-1195
Buff N Y, 220 Del Ave MO-8990
Charlotte N C, 404½ S Tryon St ..... FR 6-6453
Chi III, 1607 W Howard St ..... HO 5-5915
Cinn O, 4200 Mont Rd ..... RE 1-8156
Cleve O, 1836 Euclid Ave ..... SU 1-1202
Dallas Tex, 2030 Irving Blvd, H F Wood & Assoc ..... RI 8-4474
Denver Colo, 1940 Wazee St, Geo M Estep & Assoc ..... AM 6-1489
Des Moines Ia, 106 3rd St ..... AT 8-0184
Det Mich, 1840 Hilton Rd ..... LI 7-0300
Houston Tex, 831 Shirkmere Rd, Robt W McKinney & Assoc ..... UN 2-4945
K C Mo, 4020 Broadway ..... JE 1-5615
K C Mo, 4706 Holly St, Kansas City Equip Co ..... PL 3-3737
L I C NY, 42-15 Crescent St ..... ST 4-4488
Memphis Tenn, Rm 202 2071 Union ..... BR 6-6316
Milw Wis, 514 E Corcoran & Jeff ..... BR 6-0563
Mpls Minn, 334 N 1st St ..... FE 9-7883
N O La, 307 Euterpe St, John J Wood Co RA-4138
Phila Pa, 33rd & Arch Sts ..... BA 2-4430
Pgh Pa, 3530 Forbes St ..... MU 1-8512
San Fran Cal, 200 Brannan ..... YU 2-0317
Seattle Wash, 1056 4th Ave S MA-6733
Tampa Fla, 608 Tampa St, Wallace S Building 2-0229
Tulsa Okla, Box 9695, Oil Cap Supp Co ..... HI 6-6131

Librascope Incorporated, Subsidiary of General Precision Equip Corp (N Y)
Glendale Cal, 808 Western Ave, L W Imm ..... CH 5-2677
R E Hastings, Genl Mgr Commercial Div

Lincoln Electric Company The
Cleve 17 O, 22801 St Clair Ave, Wm Irrgang Pres, ... IV 1-8100
J S Rescoe, Exec VP-Sales
Appleton Wis, 217 N Locust St, Jean J Revelt ..... RE 3-7605
Atlanta Ga, 367 John St NW, N Howard Dye ..... JA 5-8494
Balt 1 Md, 1130 Park Ave, Robt W Sharp ..... SA 7-0060
Bay City Mich, 2131 Center St, Jas B Quigley ..... BC 3-3020
Bethlehem Pa, 1836 Jennings St, Albert T Bavario ..... UN 8-8671
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Buff 10 N Y, 69 Leddy St, Robt E Haas TR-5032
Canton O, Box 647, Richard K Kewley ..... GL 4-7133
Cedar Rapids Ia, Box 565, Kenneth R Ritter 1483
Charlotte 1 N C, Box 10553, Richard M Stratton ..... ED 3-7181
Chi 32 Ill, 3834 S Archer Ave, Ray Zeh ..... LA 3-4147
Cinn 13 O, 6319 Wiehe Rd, Francis H Smith ..... EL 1-0188
Cleve 17 O, 22801 St Clair Ave, Wm S Stewart ..... IV 1-8100
Col 12 O, 1221 Chesapeake Ave, Roland P Sharer ..... HU 8-4451
Dayton 9 O, 53 Park Ave, Walter W Rockway OX-7300
Denver 4 Colo, 1224 Walnut St, Merrill F Yale ..... AC 2-9533
Des Moines 15 Ia, 5311 SW 9th St, Lester G Hansen ..... AT 8-4117
Det 21 Mich, 17124 Wyomnig Ave, A Frank Boucher ..... UN 4-3952
Eveleth Minn, Box 451 (Duluth), Marshall H Ford ..... SH 1-5848
Ft Wayne Ind, 6408 Chester Blvd, Ted J Nowak HA-3259
Franklin Pa, 741 Liberty St, Chas M Richardson ..... ID 2-2519
Fresno Cal, 444 Blackstone Ave, Marion D Woods Jr 6-1294
Grd Rpds 9 Mich, 1355 Century Ave SW, Geo O Bain ..... CH 1-5645
Indpls 5 Ind, Box 55243 Uptn Sta, Royal S Martin BR-2415
K C 8 Mo, 3117 SW Blvd, Thos H. Nicholl ..... JE 1-9584
Louisville 4 Ky, 961 Baxter Ave, Wm M Davis HI-3223
L A 22 Cal, 2661 S Yates Ave, John B McCormick ..... RA 3-7281
Marion O, 420 Uhler Bldg, Alfred Tozer 2-8692
Memphis 3 Tenn, 8 E Calhoun St, Russell R Aschinger ..... JA 7-0108
Milw 9 Wis, 3117 W Mill Rd, John S McKeighan ..... FL 1-8541
Mpls 8 Minn, 3501 Hennepin Ave, Roy E Williams ..... TA 7-2524
Needham Mass, 1275 High Ave, E Larry Smith ..... NE 3-4370
Moline Ill, 215 43rd St, Richard P Lindgren ..... MO 2-5583
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Okla City 8 Okla, 1917 S Agnew, Ben E Walcott ..... ME 4-4121
Parkersburg W Va, 3405 Murdock, David E Klamfoth .....
Peoria 6 Ill, 214 Second Ave, Lawrence W O'Day 4-3154
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St Louis 10 Mo, 4427 Manchester Ave, Bernard J Brugge ..... JE 1-6516
San Fran (Emeryville 8) Cal, 1303 Stanford Ave ..... OL 5-6126
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York Pa, 3730 Laurel Lane, Gordon T Collier 47-6701
Youngstown 4 O, 1110 Academy Dr, Fred W Forsthoefel ..... RI 7-5262

Lincoln Engineering Company, Division of The McNeil Machine and Engineering Company
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Jonathan Kludt, Exec Vice Pres-Genl Mgr
R Warren Gribben, Sales Mgr Automotive Div
J Jenkins, Sales Mgr Industrial Div
R E Redenbaugh, Sales Mgr O E M Div
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Chi 16 Ill, 2415 S Mich Ave, J R LeVally Sr ..... CA 5-6022

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Det 2 Mich, 8627 Woodward Ave, M B Lawton ..... TR 5-3484
Ft Worth 7 Tex, 3341 Winthrop, Fritz Keller ..... PE 8-5451
Lg Is City 1 N Y, 48-14 36th St, E C Adams ..... RA 9-2529
L A 7 Cal, 2844 S Grand Ave, L L Meikle ..... RI 8-0151
Maplewood N J, 1603 Springfield Ave, N Jacobus ..... SO 2-9525
Milw 10 Wis, 3057 N 35th St, G M Lunz ..... UP 1-9400
Pawtucket R I, 587 Pawtucket St, A V Dugan ..... PA 2-7400
Phila 32 Pa, 3117 N Broad St, C A Lillmars ..... SA 2-6421
Pgh 6 Pa, 134 S Whitfield, E A Downing ..... MO 1-1444
Port 14 Ore, 1018 SE 8th Ave, E A Craven ..... BE 4-7469

Linde Company, Division of Union Carbide Corporation
N Y 17 N Y, 30 E 42nd St, W M Haile ..... MU 7-8000
Representatives in Principal Cities

Linde Company, Division of Union Carbide Corporation
Okla City Okla, 2734 S High St, M C McCool, Pres ..... ME 7-9692
Howard Braymer, Sales Mgr
Bakersfield Cal, Box 1618, W C "Casey" Jones ..... FA 2-6512
Casper Wyo, 235 W 1st St, R K Cooper 2-0839
Fairfield Ill, c/o Leslie Stallings RR No. 5, Lloyd Glick .....
Farmington N M, 627 E Main, Jim Black .....
Great Bend Kans, 3219 17th St, Noel Swick ..... GI 3-4415
Houston Tex, 1209 Maury, Mr. Crenshaw ..... CA 4-9371
Odessa Tex, 112 N Wash, H W Denton ..... FE 2-5922
Salem Ill, E 50 Highway, Joe H Perry Sr 624
Shreve La, 1102 N Market, M T Harrell 5-1579

Link-Belt Company
Chi 1 Ill, Prudential Plaza, Dept PEBG-58 ..... RA 6-7790
R C Becherer, Pres
D E Davidson, VP-Sales
Albany 6 N Y, 21 Colvin Ave 89-2589
Atlanta Ga, 1116 Murphy Ave SW ..... PL 5-5701
Balt 18 Md, 2315 St Paul St ..... HO 7-7112
Birm 9 Ala, 321 Oxmoor Rd ..... TR 1-1101
Boston 15 Mass, 136 Brookline Ave ..... CO 6-1001
Buff 23 N Y, 956 Kenmore Ave RI-8518
Charlotte 2 N C, 112 S Tryon St ..... ED 2-7523
Chi 9 Ill, 301 W Pershing Rd ..... AT 5-4401
Cinn 2 O, 138 E Court St ..... MA 1-7662
Cleve 20 O, 3592 Lee Rd ..... WY 1-0380
Dallas 21 Tex, 500 Good-Latimer Expwy ..... RI 1-5321
Denver 2 Colo, 1626 Wazee S, Schloss & Shubart ..... AC 2-2741
Det 4 Mich, 5938 Linsdale Ave ..... TY 4-1100
Duluth 2 Minn, 301 W First St ..... RA 7-2915
Grd Rpds 7 Mich, 1330 Burton St SE ..... CH 1-1654
Houston 1 Tex, 3203 S Wayside ..... WA 3-5581
Huntington 1 W Va, 1009 Fifth Ave 3-9401
Indpls 6 Ind, 220 S Belmont Ave ..... ME 2-5411
Jacksonville 2 Fla, 137 E Forsyth St ..... EL 6-8150
K C 8 Mo, 2630 Holmes St ..... VI 2-9234
L A 22 Cal, 1200 Sycamore St (Montebello) ..... RA 3-9341
Louisville 2 Ky, 235 E Burnett St ..... ME 7-3668
Milw 3 Wis, 808 N 3rd St ..... BR 2-1674
Mpls 5 Minn, 200 Lyndale Ave N ..... FE 3-5575
Moline Ill, 1614½ Fifth Ave ..... MO 2-5564
N O 12 La, 747 Tchoupitoulas St, R J Tricon Co RA-5928
N Y 36 N Y, 530 Fifth Ave ..... OX 7-8100
Phila 40 Pa, 2045 W Hunting Pk Ave ..... BA 3-3300
Pgh 13 Pa, 5020 Centre Ave ..... MU 1-0600
Port 10 Ore, 3030 NW Ind St ..... CA 6-2601
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Salt L City 1 Utah, 108 S 4th West St ..... DA 2-2539
San Fran 24 Cal, 400 Paul Ave ..... JU 7-6400
Seattle 4 Wash, 3405 6th Ave S SE-8200
Shreve La, 3109 Alex St 8-3517
Spokane 10 Wash, N 1303 Wash St ..... FA 8-5820
Summit N J, 293 Morris Ave ..... CR 3-2500
Wash 1 D C, 740 11th St NW ..... NA 8-3400
Wilm 43 Del, 805 Orange St 5-1556

L-K Pump Valve Company
Houston Tex, 632 N. Edgewood, L H Kennon, Pres ..... WA 6-2623
J H Higgins, Sales Mgr

Liquidometer Corporation
Lg Is City 1 N Y, 41-03 36th St, C de Giers ..... ST 4-1440
H T Cullinan, VP-Gen'l Sales Mgr
E F Newkirk, Mgr Ind Div

Arthur D Little Incorporated
Cambridge 40 Mass, 15 Acorn Pk, Raymond Stevens ..... UN 4-5770
Warren Berg, Sales Mgr
Chi 6 Ill, 9 S Clinton St, John Kirkpatrick ..... FR 2-8681
L A 17 Cal, 727 W 7th St ..... TR -4655
N Y 17 N Y, 420 Lex Ave, Richard Coveney ..... OR 9-5060
San Fran 11 Cal, 314 Battery St, Christian Mathews ..... YU 2-2875
Wash 6 D C, 1625 Eye St NW, C Lincoln Jewett ..... ST 3-7112

Litwin Engineering Company Incorporated
Wichia 2 Kans, 204 N Waco, Harry Litwin, Pres ..... AM 5-9543
Houston Tex, 7311 S Main, R L Huff ..... MO 7-9174

L O F Glass Fibers Company
Toledo 1 O, 1810 Mad Ave, R H Barnard Sr
J D Bettridge, Mgr Distribution Sales
C F Hegg, VP-Gen'l Sales Mgr
Milton W Gregory, Sales Mgr Mat Products Div
Atlanta Ga, 1132 W Peachtree St NW, R G Cox ..... TR 5-7149
Bellevue Wash, 2432 W Lake Sammamish Pky, R D Dorse ..... GI -0065
Burbank Cal, 3116 Van Owen Blvd, J T Podorean ..... VI 9-2331
Charlotte N C, 212½ N Independence Blvd, R H Barnard ..... FR 5-4694
Chi 1 Ill, 230 N Mich St, J J Secor Jr ..... AN 3-7417
Cinn O, 3448 Kleeman Rd, F W McPeek ..... HU 1-5007
Cleve 2 O, 8905 Lake Ave, W H Samberg ..... AT 1-3311
Dallas 16 Tex, 1518 Whispering Trail, R N Heyman ..... WH 3-8400
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K C 8 Mo, 2201 Grand Ave, W F Moll ..... BA 1-3688
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Narberth Pa, 104 Essex Ave, W R Browne ..... MO 4-8552
N Y 17 N Y, 441 Lex Ave, E A McCabe ..... MU 2-3150
Newtonville 60 Mass, 701 Wash, C E Shepperly ..... DE 2-7040
Rich Va, 2344 Leah Rd, R E Baginski ..... AT 2-6833
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Syracuse 2 N Y, 317 State Tower Bldg, G R Frick ..... GR 1-0684
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Wash 5 D C, 1010 Vermont Ave, W M Temple ..... EX 3-1919

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Phila 6 Pa, 205 Race St, R V Smith, VP-Genl Mgr ..... MA 7-4750
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Atlanta Ga, 111 Tuxedo Terr NW, Lewis M Crowe Co
Balt Md, 330 E 25th St, Shanklin Co
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Buff N Y, 14 Lafayette Sq, J Bert Slater
Chi 6 Ill, 605 W Wash St, Stolley and Orlebeke
Cinn O, 1720 Section Rd, Chapman Engrg Sales Co
Cleve 7 O, 1585 W 117th St, H R Bowers Co
Des Moines 9 Ia, 1112 Locust St, Deco Engrg Products
Det 12 Mich, 7145 E Favison St, Metrol Co
El Paso Tex, 2918 Madera, Steel & Engrg Prods Co
Houston Tex, 524 N Hutcheson St, J F Herold Supp Co
Indpls 4 Ind, 115 N Penn St, DeHaven Engrg Co
Kalamazoo Mich, 420 W South St, Metrol Co
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Memphis Tenn, 1565 Harbor Ave, Process & Power Equip Co
Milw 9 Wis 4385 N Green Bay Ave, Geo H Fredricks & Co
Nashville Tenn, 1916 8th Ave, R E Gardner
N O 6 La, 232 Canal St, Edgar Murray Supp Co
N Y 38 N Y, 5 Beekman St, Energy Control Co
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North Haven Conn, 31 State St, Energy Control Co
Oswego N Y, 12 E Bridge St, Northeastern Assoc
Pgh 19 Pa, 501 Alcoa Bldg, D D Foster Co
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San Fran 3 Cal, 637 Minna St, J O Martin Co
Seattle Wash, 418 8th Ave, Fred G Greaves Co
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Tulsa 4 Okla, 1437 S Main St, Jas E Dyer Co
Wash D C, 1st & N Sts, Thos Somerville Co

Lone Star Steel Company
Dallas Tex, 4501 W Mockingbird Lane, E B Germany ..... FL 2-3981
Walter Moreland, Sales Mgr

Lufkin Foundry and Machine Company
Lufkin Tex, Box 58, W W Trout, Pres 3-4421
L A Little, Genl Sales Mgr
Bakersfield Cal, 30th & "M" Sts, Carl Frazer ..... FA 7-8564
Casper Wyo, Box 1849, Don Bowcutt 3-4680
Corpus Christi 15 Tex, 207 S & S Bldg, John Swanson ..... TU 3-1881
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Denver 2 Colo, 1423 Mile High Ctr, Jim Roe ..... AL 5-1616
Effingham Ill, 407 W Fayette St, L W Breeden 667-W
Farmington N M, Box 1554, G W Nichols ..... DA 5-2023
Great Bend Kans, Box 82, Oliver McKay ..... GL 3-5622
Hobbs N M, Box 104, Marion Hightower ..... EX 3-5211
Houston 2 Tex, 1408 C & I Life Bldg, W H Miner ..... CA 2-0108
Kilgore Tex Box 871, W T Crowder ..... -3875
Lafayette La, Box 1353 OCS, B C Burnette ..... CE 4-2846
L A 1 Cal, 5959 S Alameda, V J Fawcett ..... LU 5-1201
Midland Tex, 1610 North "K", Geo Henson ..... MU 4-8600
Natchez Miss, 3701 Ridgewood Rd, A L Christina ..... -4691
N Y 6 N Y, 149 Bwy, A V Simonson ..... BA 7-0562
Odessa Tex, Box 1632, Elvin Read ..... FE 7-8649
Okla City 6 Okla, 108 Classen Terr Bldg, Chas Dyer ..... JA 4-2554
Pampa Tex, 2017 Mary Ellen, Jim Brown ..... MO 4-2401
Seminole Okla, 312 8th St, Newell Lynch ..... - 34
Shreveport La, Box 673, T A Banta 5-3451
Sidney Mont, Box 551, Ray Lilley ..... - 861
Tulsa 3 Okla, 1515 Thompson Bldg, D A Reid ..... DI 3-0204
Wichita Falls Tex, Box 2465, Ernest Slaughter 2-1967

Lukens Steel Company
Coatesville Pa, C L Huston Jr, Pres ..... CO -2000
W Harrison Lackey, Genl Sales Mgr
Chas A Carlson Jr, Field Sales Mgr
Albany 7 N Y, 11 N Pearl St ..... AL 4-2157
Boston 10 Mass, 20 Prov St, R B Bachman ..... HU 2-4031
Buff 5 N Y, 1731 Hotel Statler, C H Pyle ..... MO 8180
Chi 4 Ill, 332 S Mich St, Samuel Wit ..... WE 9-3880
Cinn 37 O, 1720 Section Rd, J F Weaber ..... RE 1-2441
Cleve 14 O, 1201 Citizens Bldg, G Copeland ..... MA 1-9116
N Y 7 N Y, 233 Bwy, W C Simpson ..... RE 2-1324
Pgh 19 Pa, 429 4th Ave, F J Meyer ..... GR 1-1427
Rich Va, Cent Natl Bk Bldg, J M Glazebrook 3-5303
San Marino Cal, 475 Huntington Dr, D E McElroy ..... SY 9-6793
San Mateo Cal, 20 N San Mateo Dr, R A Westman ..... DI 2-3568

Lummus Company The
N Y 17 N Y, 385 Mad Ave, J F Thornton, Pres ..... PL 9-1180
D Fulton, Sales Mgr N Y Div
J K Logan, Sales Mgr Houston Div
F J McGovern, Sales Mgr Chi Div
Chi 5 Ill, 600 S Mich Ave, F J McGovern ..... HA 7-1851
Houston 6 Tex, 2707 Weslayan Rd, J K Logan ..... MA 3-4411

Lunkenheimer Company The
Cinn 14 O, Beekman St & Wav Ave, Paul M Arnall, Pres ..... WA 1-3400
Melvin W Pauly, VP-Sales
Boston 10 Mass, 291 Congress St, H T Wilber ..... LI 2-8091
Chi 6 Ill, 558 W Randolph St, J W Montgomery ..... ST 2-6654
N Y 17 N Y, Chrysler Bldg, R S Howes ..... MU 6-2235
Phila 34 Pa, 3209 "B" St, R J Sardieck ..... GA 3-3300

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Dubuque Ia, 12th & Pine Sts, D L McDonald, Pres 3-7311
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Jess Walker, Sales Mgr Oil Equip Div
R D McDonald, Sales Mgr Oil Equip Div
Allison Pk Pa, 259 Victoria Dr, R W Will ..... HA 6-2089
Atlanta 5 Ga, 950 Cardova Dr NE, H K Adams Jr ..... CE 7-5914
Carmel Ind, Box 624, R F Connor ..... WA 5-5534
Cedar Rapids Ia, 800 "H" Ave NW, A G Dyson ..... EM 3-7600
Chi Ill, 2307 Rosemont Ave, R J Sahm ..... HO 5-6943
Cinn O, 6914 Miami Rd, R C Ford ..... BR 1-2760
Dallas Tex, 10104 Woodgrove Dr, C L White ..... DA 8-1183
Det 28 Mich, 5774 Brace, G W Henley ..... LU 4-1427
Ft Wayne Ind, 401 W Rudisell, F R McKay ..... HA -2779
Jamestown N C, Box 126, L C Wittmann ..... HP 5-7470
Lakewood 5 R I, 25 Frost Ave, D G McClain ..... WI 1-0405
Memphis Tenn, 2209 Mad Ave, A N Spencer ..... BR 8-6481
Mpls 20 Minn, 1301 E 92½ St, K Kliest ..... TU 1-2486
Paoli Pa, Savings Assn Bldg, A E Byecroft
Plainfield N J, 1285 Denmark Rd, O V Gibbons 6-1441

Arthur G McKee and Company
Cleve 1 O, 2300 Chester Ave, H E Widdell, Pres ..... TO 1-2300
Myron J Livingston, VP-Sales
N Y 20 N Y, 30 Rockefeller Plaza Rm 4610, J E Brennan ..... CI 7-6060
Wash 5 D C, 1507 M St NW, J H VanVleck ..... AD 4-6171

Macco Corporation
Paramount Cal, 14409 S Para Blvd, John MacLeod, Pres ..... NE 6-1261
E Van Dornick, Mgr Refy & Chem Div
Edw A Pellegrin, Genl Sales Mgr
Houston 6 Tex, 2506 Richton, R L Reid ..... JA 8-0804
N Y N Y, 630 Fifth Ave, Alex H Chapman ..... CI 6-1070

Mack Iron Works Company The
Sandusky O, 100 Warren St, L M Bacon, Pres ..... MA 6-3712
John L Bacon, Sales Mgr

Madsen Works, Division of Baldwin-Lima-Hamilton Corporation
La Mirada Cal, 14120 E Rosecrans, Henry Barnhart, Pres ..... UN 3-5761
Alex Kostyzak, Sales Mgr

Magnaflux Corporation
Chi 31 Ill, 7300 W Lawrence Ave, F B Doane, Pres ..... UN 7-8000
R O Schiebel, VP-Sales & Mrktg
Cleve 15 O, 3317 Prospect Ave, R N Baughman ..... HE 2-0727
Dallas 35 Tex, 2823 Manor Way, J R Harrer ..... FL 2-2626
Det 11 Mich, 2777 E. Grand Blvd, M Van Baalen ..... TR 3-4343
L A 22 Cal, 2300 S. Garfield, K A Skeie ..... RA 3-8961
N Y 36 N Y, 25 W 43rd St, R G Strother ..... BR 9-1716
Pgh 36 Pa, 5161 Brownsville Rd, A K Saltis ..... TU 2-3448

Magnet Cove Barium Corporation, Division Dresser Industries Inc
Houston 5 Tex, 3133 Buff Speedway, Geo H Moore ..... JA 9-4611
Robt L Snook, Sales Mgr Southwestern Div
H M Gwyn Jr, Sales Mgr Eastern Div
Gerald Morrical, Sales Mgr Midwestern Div
Des Plaines Ill, 576 NW Hwy, Gerald Morrical ..... VA 7-3276
Houston 5 Tex, 3133 Buff Speedway, Robt L Snook ..... JA 9-4611
Phila Pa, 703 Western Sav Fund Bldg, H M Gwyn Jr ..... PE 5-0323

Magnetrol Incorporated
Chi 23 Ill, 2110 S Marshall Blvd, R F Schaub, Pres ..... BI 7-4000
Lester E Stybr, Sales Mgr
Representatives in Principal Cities

Magnus Chemical Company Incorporated
Garwood N J, South Ave, W M Campbell, Pres ..... SU 9-0200
E H Peterson, Sales Mgr Chemical Div
A W Bowling Sales Mgr Equipment (Cleang Machs) Div
L Salz, Sales Mgr Lubricants Div
J D Holmes, Sales Mgr Power Plant Serv Div
R Edmonds, Sales Mgr Fin & Coatings Div
Altadena Cal, 1360 Boston St, E H Heintz
Chi Ill, 2155 W Hubbard St, R J Rohr

Maintenance Engineering Corporation
Houston 20 Tex, 3711 Clinton Dr, W J Peddie ..... CA 2-2351
E B Haldeman, Sales Mgr
Corpus Christi Tex, 225 Campbell Lane, J B Fargerson ..... TU 3-6446
Shreve La, 1309 N Markt St, D R Carroll 3-2387

Mallinckrodt Chemical Works
St Louis 7 Mo, 3600 N 2nd St, Jos Fistera, Pres ..... CE 1-8980
W D Barry, Sales Mgr Eastern Div
W S Kautzer, Sales Mgr Western Div
Chi 1 Ill, 307 N Mich Ave ..... ST 2-1400
Cinn 29 O, 3303 Vernon Pl ..... AV 1-6341
Cleve 9 O, 1305 Brookpark Rd ..... SH 9-1040
Det 4 Mich, 8730 W Chi Blvd ..... WE 3-0444
L A 58 Cal, 3016 E 44th St ..... LU 3-2237
N Y 8 N Y, 72 Gold St ..... WO 4-4900
Phila 6 Pa, 311 N 3rd St ..... MA 7-0235
San Fran 4 Cal, 465 Cal St ..... SU 1-4748

Manning and Lewis Engineering Company
Newark 4 N J, 28 Ogden St, Henry S Lewis, Pres ..... HU 2-1646
H G Gamble, Sales Mgr

Manning, Maxwell & Moore Inc
Stratford Conn, 250 E Main St, J Robert Kelley, Pres ..... DR 8-2681
A W Coleman, Genl Sales Mgr Consol Ashcroft Hancock Div
K W Peterson, Sales Mgr Industrial Controls Div

Manning, Maxwell and Moore Incorporated, Shaw-Box Crane & Hoist Division
Muskegon Mich, A R Walkley, Genl Mgr 31-311
G A Andree Sales Mgr Shaw-Box Div
Atlanta Ga, 1036 Peachtree NE, H E Dey
Chi (Bellwood) Ill, 2600 W Van Buren, C E Vanderlinde
Dallas Tex, 4227 Herschel St, T E Williams
N Y 17 N Y, 161 E 42nd St, H F Morse
Pgh 22 Pa, 1412 Park Bldg, J P Leland
San Fran Cal, 1295 Folsom St, C H Dawson

C L Mantell and Associates
N Y 13 N Y, 457 Wash St ..... CA 6-4028

Manzel, Division of Houdaille Industries Incorporated
Buff 10 N Y, 315 Babcock St, Granger B Thurstone, Mgr FA-5300
Robert W Meyers, Sales Mgr Manzel Div
Bellaire Tex, 5610 Evergreen St, J B Marz ..... MO 5-1926
Chi 30 Ill, 6539 N Minnehaha St, Becker Engrg & Supply ..... .
Collingswood N J, 530 Highland Ave, W B Myers ..... CO 5-2524
Det 7 Mich, 3020 E Canfield, Cox Engrg & Sales Co ..... WA 5-9737
E Meadow L I NY, 773 Buchanan Rd, Chas Oberst ..... IV 9-2746
Euclid 17 O, 1761 Sagamore Dr, M T Baird ..... KE 1-4670
Little Rock Ark, 3001 Ozark Ave, L L Scharff ..... MO 3-6659
L A 22 Cal, 3528 S Garfield Ave, Warren & Bailey Co ..... RA 3-7181
Midland Tex, 3212 W La, Ralph Nelson ..... MU 2-2745
Pgh 6 Pa, 121 S Highland, Sloan Bros Co ..... MO 1-2356
Port Ore, 1801 NW Northrup St, D R Munro ..... CA 6-3808
St Louis 20 Mo, 6110 Garesche Ave, Carl F Gast Co ..... EV 3-0750
San Fran Cal, 630 Darien Way, P B Boone ..... DE 4-0388
Tulsa 9 Okla, 2229 S St Louis St, E C Bromiley ..... RI 2-0525

Marley Company The
K C 14 Mo, 222 W Gregory Blvd, L T Mart, Pres ..... EM 1-2222
F B Reed, Sales Mgr
Alhambra Cal, 924 E Main St, V A May ..... CU 3-2747
Chi 7 Ill, 111 W Wash St, R L McFadin ..... RA 6-1926
Cinn 8 O, 3455 Edwards Rd, W G Cramer ..... EA 1-3880
Houston 19 Tex, 2132 Welch, R W Maze ..... JA 6-2591
K C 3 Kans, 2500 Johnson Dr, W O Kretzmeier ..... SK 1-1930
N Y 6 N Y, 75 West St, H J Bierman ..... BO 9-0325
Phila 7 Pa, 12 S 12th St, R M Sharp ..... MA 7-7958
San Fran 11 Cal, 420 Mrkt St, O E Bloebaum ..... DO 2-2522
Wash 5 D C, 777 14th St NW, W V McCoy ..... ME 8-6747

Marlow Pumps, Division of Bell and Gossett Company
Midland Pk N J, Box 200 ..... GI 4-6900
A F Woods, Sales Mgr Marlow Pumps Div
F R Paris, Asst Sales Mgr, Longview Tex
J J Jordan, Regional Sales Mgr
Longview Tex, Box 311, W H Van Blarcome ..... PL 3-3702
Morton Grove Ill, 8200 N Austin Ave, J J Jordan ..... IN 3-4040

Jas P Marsh Corporation, Division of Marsh Instrument Company
Skokie Ill, 3501 Howard St, Barrett Scudder, Pres ..... OR 3-4300
R E Barnett, Genl Sales Mgr

Mason-Neilan, Division of Worthington Corporation
Norwood Mass, Nahatan St, F K Morrison, Pres ..... NO 7-4600
C W Gram, VP-Sales
A B Powell, Sales Mgr
Atlanta 9 Ga, 1132 W Peachtree St, E P Head ..... TR 2-2782
Birm 9 Ala, Mountain Brook, L M Chester ..... TR 1-4363
Buff 2 N Y, 232 Delaware Ave, E Pache MA-7351
Charlotte 2 N C, 112 S Tryon St, J H Morrison ..... FR 6-4630
Chi 11 Ill, 435 N Mich Ave, C H Hoyt Jr ..... SU 7-3733
Jacksonville 4 Fla, 115 Park St, M D Duncan ..... EL 5-5079
L A 23 Cal, 2822 E Olympic Blvd, A M Thackara ..... AN 1-4148
N Y 22 N Y, 375 Park Ave, R O Smith ..... EL 5-1525
Phila (Upper Darby) Pa, 6908 Market St, C W Wood ..... GR 6-7141
Pgh 34 Pa, 3833 Willow Ave, J W Brown ..... LO 1-7511
San Fran 5 Cal, 525 Market St, D A Stevenson ..... EX 7-0550
Seattle 99 Wash, 912 Elliott Ave W, T S Robinson ..... AT 2-0141
Skaneateles N Y, 9 E Genesee St, T M Nee SK-555
Wilmington Del, 100 W 10th St, A S Chatfield ..... OL 8-4386

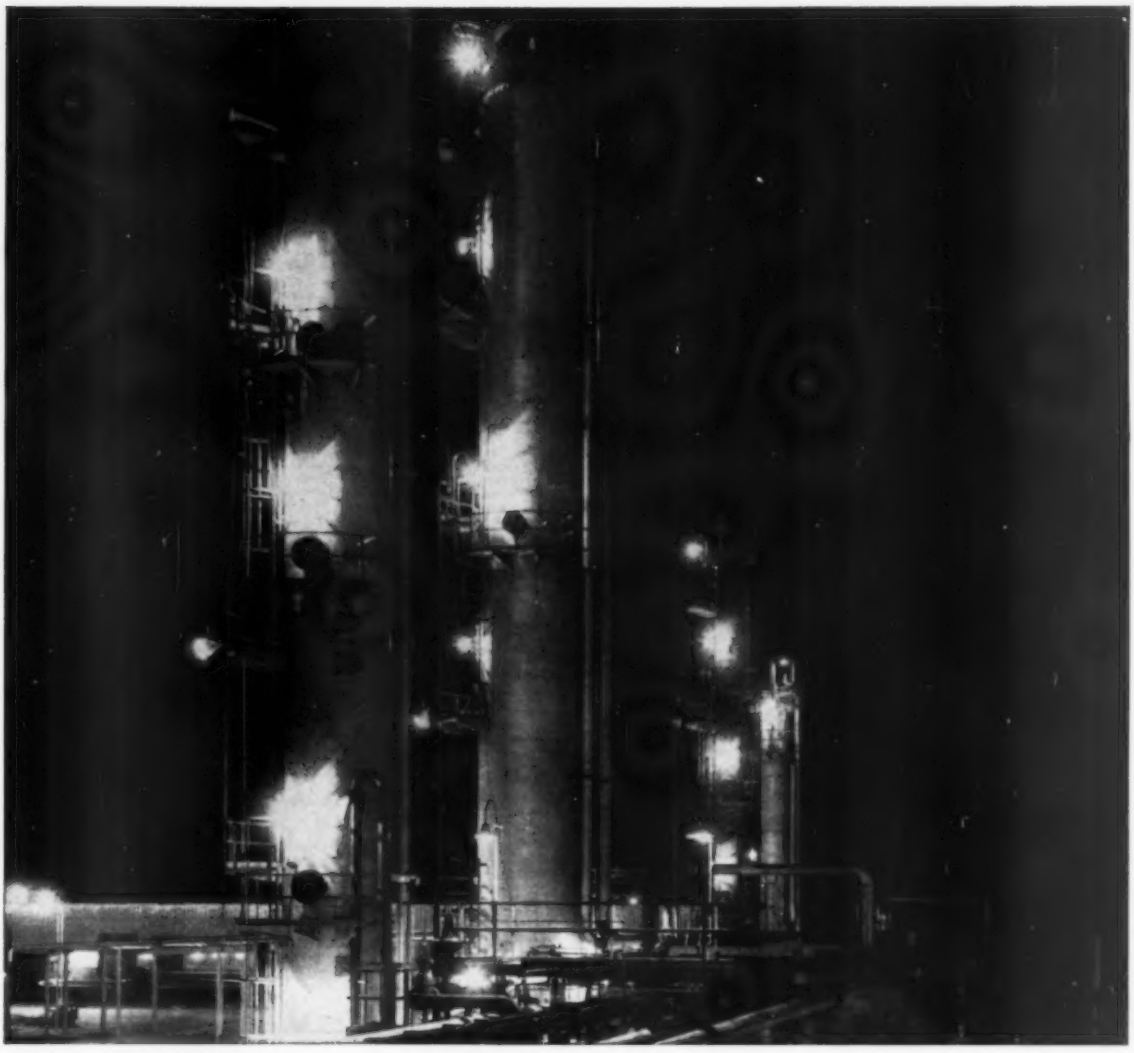
Matheson Company Incorporated The
E Rutherford N J, 932 Paterson Plk Rd, David Ross, Pres ..... WE 3-2400
K E Hoag, Sales Mgr Mid-West Reg
F D Livelli, Sales Mgr Eastern Reg
Joliet Ill, Richards St & Manhattan Rd, R Sterrett ..... JO 2-8723
Newark Cal, Magnolia & Cent Aves, Frank Powers ..... NE 3-2666
Norwood 12 O, 2909 Highland Ave, K E Hoag ..... ME 1-3222

L A Mekler, Consulting Engineer
N Y 17 N Y, 525 Lex Ave ..... MU 8-1243

Meriam Instrument Company The
Cleve 2 O, 10920 Mad Ave, J B Meriam Jr ..... AT 1-1100
Leroy E Rogers, Sales Mgr Instr Div
A A Hejduk, Sales Mgr Test Stand Div
Atlanta 5 Ga, 3120 Maple Dr NE, Ward K Stallings EX-0600
Berkeley 2 Cal, 920 Grayson St, G M Cooke ..... TH 5-5110
Buff 7 N Y, 1807 Elmwood Ave, R H Perry BE-2318
Charlotte 1 N C, 133 S Brevard St, W B Simons Jr ..... FR 6-8531
Chi 43 Ill, 10336 S Western Ave, P B Shannon ..... CE 3-3392
Cinn 2 O, 427 Temple Bar Bldg, E Roy Myers ..... DU 1-7783
Cleve 7 O, 1585 W 117th St, H R Bowers ..... AC 1-8442
Det 7 Mich, 1900 E Jeff Ave, W Dolch ..... LO 7-3550
El Paso Tex, 2918 Madeira, Ivan Lockwood 3-5521
Houston 1 Tex, 4220 Jeff Ave, Mel Smith ..... WA 3-1661
Indpls 20 Ind, 5775 N Hillside Ave, J B Brill ..... CL 1-1132
L A 22 Cal, 5017 Telegraph Rd, C Meriam ..... AN 9-8271
Marshalltown Iowa, Kresge Bldg, R S Stover 5557
Memphis 12 Tenn, 2717 Union Ave, J L Shilano 33-1275
Mercer Is Wash, Box 158; R Tower AD-1460
Milw 11 Wis, 153 E Silver Spg, G Chipley ..... WO 2-4710
Mobile Ala, Box 1615, F A Thomas ..... HE 3-4170
N O 12 La, Bd of Tra Annex Bldg, Wm S Huey TU-0409
N Y NY, 342 Mad Ave, Ted Dande ..... MU 2-2420
Phila 4 Pa, 225 N 32nd St, K Swartz ..... EV 2-6400
Pgh 20 Pa, 4 W Manilla Ave, H A Woolman ..... WA 2-2420
Pompano Bch Fla, 330 SE 15th Ave, K L Diller 3-3781
Rich Va, 300 E Main St, W H Kidd 2-9240
St Louis 20 Mo, 6110 Garesche Ave, C F Gast ..... EV 3-0750
St Paul 4 Minn, 1879 Univ Ave, J L Schmidt ..... MI 6-6383
Salt L City Utah, Box 19 Sugarhouse Sta, W Wiscomb 841-662
Syracuse 14 N Y, Box 211 DeWitt Branch, C Sayres ..... GI 6-1720
Tulsa 9 Okla, 303 S Frankfort, H W Arduser 7-8311
W Newton 65 Mass, 1449 Wash St, Wm B Wickersham ..... BI 4-4020

Mercoid Corporation The
Chi 41 Ill, 4201 Belmont Ave, Hugh Courteol, Pres ..... PE 6-2100
W E Jones, Sales Mgr
N Y 17 N Y, 205 E 42nd St, John Sheden ..... MU 4-5071
Phila 32 Pa, 3137 N Broad St, F W Ayer ..... BA 5-1800

For additional information on products, services, and prices, use the enclosed Business Reply Cards.



More light on producing hydrogen economically ...Tidewater uses heat-resistant Incoloy tubing

The hydrogen plant at Tidewater Oil Company's new Delaware Refinery is the first such unit ever built to supply a refinery's desulfurizer. Capacity is 30 million cubic feet of hydrogen per day.

High temperature-pressure problem

Metal temperatures in the reformer furnaces are in excess of 1700° F with internal pressures of the reacting gases sufficiently high to emphasize the need for strength and ductility. To provide these properties, the tubes in one furnace are made of extruded Incoloy* nickel-iron-chromium alloy.

Incoloy is the solution

Incoloy alloy exhibits high creep strength and rupture strength combined with satisfactory ductility. It is not susceptible to embrittlement resulting from structural changes after prolonged heating. Of special importance in containing hydrogen under pressure is the ability of the alloy to provide welds of high integrity. Furthermore, when used in the extruded form, the alloy offers decided economies over other materials.

Incoloy alloy is also used here in the reformer heater outlet manifold and reformer outlet to desuperheater.

For more information, or for help with a high temperature or corrosion engineering problem of your own, write Inco's Development and Research Division.

*Registered trademark

The International Nickel Company, Inc.
67 Wall Street (INCO) New York 5, N. Y.

INCO NICKEL ALLOYS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

COMPANY DIRECTORY

Metallo Gasket Company
New Brunswick N J, 16 Bethany St, S S Geipel, Pres ... KI 5-7223
G K Mordas, Sales Mgr

Metal Textile Corporation, Subsidiary of General Cable Corp
Roselle N J, 647 E First Ave, Spencer DeMille, Pres ... CH 5-3000
P P Uskaritys, Sales Mgr Mist Elim Div
Baton Rouge La, Metal Goods Corp ... 2-3238
Beaumont Tex, Metal Goods Corp ... TE 3-7536
Corpus Christi Tex, Metal Goods Corp ... TU 4-0366
Dallas Tex, Metal Goods Corp ... FL 1-3271
Denver Colo, Metal Goods Corp ... DU 8-4141
Houston Tex, Metal Goods Corp ... FA 3-0141
K C Mo, Metal Goods Corp ... GR 1-3516
L A Cal, Thomas Machy Sales Inc ... CL 5-1441
Memphis Tenn, Metal Goods Corp ... WH 8-3407
N O La, Metal Goods Corp ... CA-7373
St Louis Mo, Metal Goods Corp ... HA 7-1234
San Ant Tex, Metal Goods Corp ... CA 7-3161
San Fran Cal, M O Grove & Co ... YU 6-1611
Shreve La, Metal Goods Corp ... 8-8464
Tulsa Okla, Metal Goods Corp ... GI 7-4101
Wichita Kans, Metal Goods Corp ... AM 5-3191

Mexico Refractories Company
Mexico Mo, Love & Coat Sts, Basil W Leach, Pres ... JU 1-1250
Basil W Leach, Sales Mgr FireBrick Div
E C Tinsley, VP-Sales Mgr Specialties Div
Baton Rouge La, 3337 Carol Dr, Frank B Boyd Jr ... DI 2-0290
Boston 6 Mass, 442 Statler O ce Bldg, John W Foltz ... HA 6-7825
Chi 32 Ill, 2810 W 38th St, Carl Von Luhrte ... VI 7-2211
Cleve 15 O, 1672 Hanna Bldg, Robt J Artman ... MA 1-1406
Emeryville Cal (San Fran O ce) 1372 Ocean Ave, Arthur B Morse ... OL 4-4797
Houston 1 Tex, 2211 Walker, Morris W Lindsey ... FA 3-0307
L A 58 (Vernon) Cal, 4555 Pac Blvd, W E Daugherty ... LU 3-3468
K C 8 Mo, 1727 Walnut, C N Eubank ... GR 1-5657
N Y 6 N Y, 21 West St, Chas A Paul ... BO 9-8862
Phila 2 Pa, 226 S 16th St Bldg, Roger A Hitchins ... KI 5-1447
Pgh 22 Pa, 1447 Oliver Bldg, John J Isherwood ... AT 1-5030

Micro Switch, Division of Minneapolis-Honeywell Regulator Company
Freeport Ill, 11 W Spring St, W W Gilmore, Pres ... ST 4-400
F E Wilsey, Sales Mgr
Boston 35 Mass, 1230 Soldiers Fld Rd, W J Greaser ... AL 4-3939
Charlotte 3 N C, 212 Greystone Rd, D S Schultz ... ED 3-2908
Chattanooga 11 Tenn, 3223 Brainerd Rd, G U Messner ... OX 8-1585
Chi 80 Ill, 7350 N Lincoln Ave, E L Scheiblauer ... IR 8-9290
Cleve 14 O, 1900 Superior Ave, C J Albertz ... PR 1-0920
Dallas 6 Tex, 6000 N Cent Expwy, W C Burkhard Jr ... EM 1-6227
Dayton 4 O, 1441 Milburn Ave, M H Bente ... HE-4615
Denver 4 Colo, 1600 W 13th Ave, R J Petersen ... AM 6-2491
Det 27 Mich, 13631 Plymouth Rd, T E Bolenbaugh ... TE 4-6028
Indpls 2 Ind, 1905 W 18th St, R E Doll ... ME 5-2149
L A 22 Cal, 6620 Telegraph Rd, A C Kibbler ... RA 3-7104
Mpls 8 Minn, 2753 4th Ave S, H F Bares ... FE 2-5225
N Y 1 N Y, 24 Skillman Ave, J J Tropsa ... ST 6-5005
Phila 32 Pa, 3345 W Hunting Pk Ave, R A Heinrich ... BA 6-2400
Phoenix Ariz, 4125 N 7th Ave, J A Olson ... CR 4-7791
Roch 11 N Y, 841 Maple St, D S McQuiston ... GE 8-0425
St Louis 8 Mo, 4354 Olive St, R R English ... JE 1-4691
San Fran 24 Cal, 2 Dorman Ave, F W Peters ... AT 8-1221
Seattle 9 Wash, 401 Pontius Ave N, E D Veal ... MU-4580
Union N J, US Rte 22 at Springfld Line, A H Bahnsen ... MU 8-8740
Wash 16 D C, 4926 Wis Ave NW, C T Morison ... EM 2-9050

Midcontinent Tube Service Incorporated
Evanston Ill, 2120 Lee St, Sam B Horwitz, Pres ... DA 8-4030
S B Horwitz, Sales Mgr Carbon Steel Pipe & Tub Div
M S Abrams, Sales Mgr Alloy Pipe & Tubing Div
H Michel, Sales Mgr Valves, Flanges Fittings Div

Midwest Piping Company Incorporated
St Louis 4 Mo, 1450 S Second St, Eric A Kerbey, Pres ... MA 1-8300
Asheville N C, Box 446 (Skyland N C), S T Seeley ... MU 4-6687
Atlanta Ga, 72 11th St NE, J H Castleman ... TR 4-6114
Boston Mass, 426 1st St, K C Bowden ... AN 8-2110
Chi Ill, 79 W Monroe St, L H Niebling ... FR 2-1868
Cleve O, 216 Lincoln Bldg, N L Diadul ... TO 1-2588
Coral Gables Fla, 2103 Le Jeune Rd, A L Struven ... HI 6-0158
Houston Tex, 1213 Capitol Ave, W T Moran ... CA 7-2815
L A Cal, 520 Anderson St, G L Morrill ... AN 8-6733
NY NY, 50 Church St, T R Taylor ... CO 7-5213
Pgh Pa, 404 Frick Bldg, R H Eisentraudt ... GR 1-6151
San Fran Cal, 420 Mrkt St, H H Lewis ... EX 7-2893
Tulsa Okla, C L Doughman ...

Miller Electric Manufacturing Company Incorporated
Appleton Wis, 718 S Bounds St, N C Miller, Pres ... RE 4-9821
D R Warner, Sales Mgr

Minerals & Chemicals Corporation of America
Phila Pa, 210 W Wash Sq, Wright W Gary, Pres ... LI 8-2200
R H Hubbell Jr, VP Sales
C Y Haas, Mgr Sorptive Mineral Sales

Mine Safety Appliances Company
Pgh 8 Pa, 201 N Braddock Ave, J T Ryan Jr, Pres ... CH 1-5900
F A King, Sales Mgr Safety Prods Div
N W Hartz, Sales Mgr Tech Prods Div
Atlanta 9 Ga, 1345 Spring St NW, D F West ... TR 4-6378
Cni 10 Ill, 144 W Superior St, C R Dever ... MI 2-3575
Cleve 12 O, 17901 Euclid Ave, J W McCrackin ... KE 1-9600
Dallas 7 Tex, 1630 Oak Lawn Ave, W H Gates ... RI 7-4209
Det 3 Mich, 19725 Ralston, H N Gruber ... TO 8-5855
K C Mo, 2603 Cherry St, J S Miller Jr ... BA 1-9787
Lg Is City 1 N Y, 5-45 49th Ave, C H Mehaffey ... ST 4-1851
L A 7 Cal, 115 W 25th St, J S Moore ... RI 7-9567
Phila 3 Pa, 1614 Summer St, E C Brainerd ... LO 4-1216
Pgh 8 Pa, 7517 Penn Ave, E F Hahnfeldt ... CH 1-6332
San Fran 3 Cal, 1255 Howard St, K S Butler ... HE 1-3870
Seattle 4 Wash, 71 Columbia St, R A Pohl ... MA-6622

Minneapolis-Honeywell Regulator Company, Industrial Division
Phila 44 Pa, Wayne & Windrim Aves, Henry F Dever, Pres ... DA 9-8300
O B Wilson, VP-Genl Sales Mgr
Akron 10 O, 488 Glenwood Ave ... PO 2-8806
Albany 6 N Y ...
Albuquerque N M, 2502 Garfield Ave SE ... 7-0276
Amarillo Tex, 1505 W 10th St ... DR 3-0301
Atlanta Ga, 1415 Howell Mill Rd NW ... AT-9776
Balt 14 Md, 4612 Harford Rd ... CL 4-9070
Baton Rouge La ...
Billings Mont, 2718 Montana Ave ... 9-9975
Binghamton N Y ...
Birm 5 Ala, 2616 Seventh Ave S ... 4-7588
Boston 35 Mass, 1230 Soldiers Field Rd ... AL 4-8730
Buff 23 N Y, 1606 Kenmore Ave ... DE-9570
Charleston W Va ...
Charlotte 3 N C ...
Chattanooga 11 Tenn ...
Chi 30 Ill ...
Cinn 37 O, 7645 Production Dr ... PO 1-4500
Cleve 14 O, 1900 Superior Ave ... TO 1-1400
Cocoa Beach Fla ...
Columbia S C ...
Col 14 O, 4272 Indianola Ave ... AM 8-8681
Corpus Christi Tex, 1806 S Alameda ... TU 3-7922
Dallas 6 Tex, 6000 N Cent Expwy ... FO 8-6401
Davenport Ia, 2010 River St ... 2-7145
Dayton 4 O ...
Denver 4 Colo, 1600 W 13th Ave ... AC 2-4866
Des Moines 14 Ia, 1911 Ingersoll Ave ... 4-0348
Det 27 Mich, 13631 Plymouth Rd ... TE 4-6020
Duluth Minn ...
E Prov 16 R I ...
El Paso Tex, 102½ E Missouri St ... 3-8407
Eugene Ore ...
Evansville Ind ...
Ft Wayne 6 Ind, 3502 Quimby Arcade ... HA-4354
Fresno Cal, 446 Blackstone Ave ... FR 2-2191
Grd Rods 2 Mich ...
Greensboro N C ...
Greenville S C ...
Hammond Ind, 5719 Calumet Ave ... WE 3-0200
Harrisburg Pa ...
Hartford 14 Conn ...
Houston 1 Tex, 5440 Gulf Freeway ... WA 8-2451
Idaho Falls Idaho ...
Indpls 2 Ind, 1905 W 18th St ... ME 5-4591
Jackson Miss ...
K C 30 Mo, 4650 E US 50 Hwy ... WA 3-8725
Knoxville 17 Tenn, 1328 Buchanan Ave NE ... 5-9429
Lansing Mich ...
Little Rock Ark, 608 W Third St ... FR 2-6346
Lg Is City 1 N Y, 24-30 Skillman Ave ... EX 2-4300
L A 22 Cal, 6620 Telegraph Rd ... RA 3-6611
Louisville 8 Ky, 2000 S Brook St ... ME 7-1442
Lubbock Tex, 1415 Ave M ... 2-5483
Madison 5 Wis ...
Memphis 4 Tenn ...
Menasha Wis ...
Miami 35 Fla ...
Milw 10 Wis, 5520 W Burleigh St ... HI 5-6010
Mpls 14 Minn, 621 E Hennepin Ave ... FE 9-8551
Mobile Ala, 105 N Florida St ... GR 8-8484
Moorhead Minn ...
Nashville 12 Tenn ...
New Haven 15 Conn ...
N O 22 La, 2369 Prentiss Ave ... FA-3491
Norfolk 8 Va, 424 W 21st St ... MA 2-2356
Odessa Tex, 2020 E 8th St ... 6-9651
Okla City 18 Okla, 4501 N Cooper ... JA 8-4485
Omaha 3 Neb, 403 N Saddle Creek Rd ... RE-7557
Peoria Ill, 603 W Lake Ave ... 5-7671
Phila 32 Pa ...
Phoenix Ariz, 4125 N Seventh Ave ... CR 4-3568
Pgh 27 Pa, 4120 Brownsville Rd ... TU 2-9700
Port 2 Me ...
Port 15 Ore, 2600 SE Belmont ... BE 4-6511
Richland 14 Wash, 1329 Geo Wash Way ... RI 5-6670
Rich 21 Va ...
Roanoke Va ...
Roch 11 N Y ...
Rockford Ill, 1125 Railroad Ave ... 8-3731
Sacramento 16 Cal, 1924 28th St ... GL 5-2647
Saginaw 27 Mich ...
St Clair Shores Mich ...
St Louis 8 Mo ...
Salt L City 4 Utah, 1472 S State St ... IN 6-8628
San Antonio 13 Tex ...
San Fran 24 Cal, 2 Dorman Ave ... AT 8-0118
Scranton Pa ...
Seattle 9 Wash, 401 Pontius Ave N ... MU-5610
Shreve La, 2737 Linwood Ave ... 7-5391
Sioux Falls S D ...
South Bend 14 Ind ...
Spokane 1 Wash, 917 W Mallon ... BR-0111
Springfield 9 Mass ...
Syracuse 10 N Y ...
Tampa 6 Fla ...
Toledo 13 O, 5618 Secor Rd ... KI-5793
Tulsa 14 Okla, 117 W Eighth St ... GI 7-9151
Union N J ...
Wash 16 D C ...
Wichita 16 Kan, 2801 S Mad ... AM 7-5304
Wilm 5 Del ...
Worcester 4 Mass ...
Youngstown 2 O ...

Mission Manufacturing Company
Houston 14 Tex, Box 4209, R E White, Exec Vice Pres ... OX 4-5561
Ted Fullinwider, Sales Mgr
N Y 20 N Y, 30 Rockefeller Plaza ... CO 5-2438

Mixing Equipment Company Incorporated
Roch 3 N Y, 135 Mt Read Blvd, Fred H Gordon ... GE 8-7560
J V Donohoe, Sales Mgr

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Akron 8 O, 919 Second Natl Bldg, White Ind Sales ..... BL 3-8596
Boston 8 Mass, 8 Beacon St, Chester C Stewart ..... CA 7-0424
Buff 21 N Y, 6045 Main St, Bass Ind Equip Co PL-0600
Charleston 1 W Va, 1033 Quarrier Bldg, White Ind ..... DI 3-0146
Charlotte 1 N C, 1726 Hutchison Ave, Robt E Mason & Co ..... ED 2-1903
Chattanooga 2 Tenn, Chatt Bk Bldg, Edgar A Rogers ..... AM 7-4640
Chi 6 Ill, 549 W Randolph St, Fuente & Webster Inc ..... DE 2-3764
Cinn 6 O, 140 W 6th St, White Ind Sales & Equip Co ..... MA 1-1575
Clearwater Fla, 1136 Drew St, Johnson Roney II & Assoc 3-1136
Cleve 15 O, 227 Hanna Bldg, White Ind Sales & Equip ..... CH 1-5788
Denver 18 Colo, 847 E 17th Ave, Alldredge & McCabe ..... AL 5-7496
Dallas 6 Tex, 4924 Greenville Ave, Allan Edwards Inc ..... EM 8-4528
Det 4 Mich, 9190 Roselawn Ave, Wm A DaLee Inc ..... WE 3-4430
Houston 21 Tex, 2421 S Wayside Dr, M N Dannenbaum Co ..... WA 3-7655
Indpls 7 Ind, 1728 W 16th St, Avels Sales & Engrg Co ..... ME 2-7486
K C 8 Mo, 3249 Roanoke Rd, Allan Edwards Inc ..... WE 1-1566
L A 19 Cal, 1088 S LaBrea Ave, Frank J Bunker ..... WE 9-2646
Lafayette La, 147 Grand Ave, John H Carter Co Inc ..... CE 4-6757
Metairie La, 2551 Metairie Rd, John H Carter Co Inc ..... VE 3-8281
Mpls 3 Minn, 620 Plymouth Bldg, Geo R Mellema Co ..... FE 2-0528
N Y 6 N Y, 136 Liberty St, New York Office ..... CO 7-7015
Phila 4 Pa, 225 N 32nd St, Malcson Co ..... EV 2-6400
Pgh 22 Pa, 1312 Farmers Bk Bldg, White Ind Sales ..... GR 1-9200
Port 14 Ore, 516 SE Morrison St, Burhans-Sharpe Co ..... BE 4-1561
Rich 19 Va, 601 E Franklin St, O'Neill Pump & Eng Co 7-4828
Roch 4 N Y, 82 St Paul St, Harold E Colburn ..... BA 5-7367
Salt L City 11 Utah, 73 S Main St, Nibley & Co ..... EL 9-6045
San Fran 3 Cal, 725 Tehama St, Geo R Friederich & Co ..... MA 1-3437
St Louis 8 Mo, 3863 W Pine Blvd, Wharton L Peters ..... JE 5-3700
St Simons Is Ga, 15th St E Beach, Ray C Crumbliss 2416
Seattle 4 Wash, 1731 First Ave S, Burhans-Sharpe Co MA-9006
Shreve La, 201 Strand Bldg, John H Carter Co Inc 3-0651
Tulsa Okla, 2445 S Jackson, Allan Edwards Inc ..... DI 3-7184

Moisture Register Company
Alhambra Cal, 1501 W Chestnut St, John R Barnes ..... CU 3-3143
Reg J McLean, Sales Mgr

Monsanto Chemical Company
St Louis 24 Mo, Lindbergh & Olive St Rd ..... WY 3-1000
Charles A Thomas, Pres
Charles H Sommer, Genl Mgr Organic Div
Atlanta 5 Ga, 1401 Peachtree St NE, H A Lovejoy ..... TR 6-0777
Boston 49 Mass, Everett Sta, S U Shorey ..... EV 7-5010
Chi 11 Ill, 520 N Mich Ave, H I Armstrong ..... WH 4-6750
Cinn 6 O, 2330 Victory Pkwy, J J Feeks ..... WO 1-3677
Cleve 15 O, 427 Hanna Bldg, B B Langton ..... SU 1-3830
Det 23 Mich, 18230 Grand Riv Ave, J G Hicks ..... BR 3-7090
Houston 5 Tex, 2472 Bolsover St, W K Conwell ..... JA 6-2551
L A 22 Cal, 6670 E Flotilla St, J P Ekberg ..... RA 3-2492
Mpls 2 Minn, Foshay Tower Rm 409, A A Hibbeler ..... FE 9-4651
N Y 22 N Y, 445 Park Ave, E S Robson ..... PL 9-8200
Pgh 28 Pa, 20 Cedar Blvd, J D Wright ..... LO 3-4010
San Fran 4 Cal, 111 Sutter St, C L Fetzner ..... YU 6-6232
St Louis 24 Mo, Lindberg & Olive St Rd, A D Evans ..... WY 3-1000
Seattle 4 Wash, 911 Western Ave, A W Hempelmann MA-4203
Syracuse 3 N Y, 731 James St, R P Sullivan ..... GR 4-6001
Wilm 99 Del, 2005 Concord Pike Fairfax, D J Murphy ..... OL 8-6423

Samuel Moore and Company
Mantua O, Main & Orchard Sts, Samuel D Moore, Pres ..... CR 4-2276
Bradford Burnham, Genl Sales Mgr
Jas F Rogers, Sales Mgr Dekoron Prods Div
Albuquerque N M, 1609 Second St, Fred J Haas 2-7863
Amarillo Tex, 1817-C Wash, Snyder Co, J M Ribble ..... DR 4-7221
Baton Rouge La, Box 493, James Ware ..... DI 3-9558
Birm 9 Ala, Box 5913, Geo S Edwards Co ..... TR 1-0251
Buff 7 N Y, 1807 Elmwood Ave, O R Lawrence Co RI-5773
Celina O, 111 S Ash St, Robt A Grief 2161
Charlotte 1 N C, 113 S Brevard St, Mac-Tric Control ..... FR 6-8531
Charlotte N C, 1237 Fordham Rd, Jas E Amos
Cinn 2 O, 427 Temple Bar Bldg, E Ray Myers Co ..... DU 1-7783
Cleve 4 O, 3909 E 123rd St, Lester Johnson Co ..... SK 1-7040
Denver 11 Colo, 2548 W 29th Ave, Process Equip Co ..... GL 5-4766
Det 7 Mich, 1900 E Jeff Ave, Smith Instr & Equip Co ..... LO 7-3550
El Paso Tex, 2918 Madera St, Steel & Engrg Prods Co 3-5521
Houston 25 Tex, 1025 Lehall, Paul Condit Company ..... JA 2-1909
Glens Falls N Y, 21 Bay St, A G Hatcher 2-4528
Grd Rpds Mich, 900 N Monroe, Jack Zuiderveld-H Glick ..... GL 8-4682
K C 5 Mo, 454 Dwight Bldg, 1004 Balt Ave, C Matney ..... GR 1-6161
Maywood Ill, 1210 S 17th St, J R Simpson ..... (Chi) FI 5-1613
Mercer Is Wash, Box 158, Tower Equip Co, R L Tower AD-1460
Milw 15 Wis, 3127 W Greenfield Ave, Ray M Gordon Co ..... MI 5-1711
Mtn Lakes N J, 97 Kenilworth Rd, Herbert Grandage ..... DE 4-6220
Muskegon Mich, 3488 W Manitou Cir, Al Christopher 51-7251
Newton Conn, RD 1 Pocono Rd, Will Toll ..... GA 6-2470
N Syracuse N Y, 204 N Main St, Leroy F Van Luven ..... GL 8-0910
Phila Pa, 1418 Walnut St, Herbert Grandage ..... KI 5-6094
Pgh 16 Pa, 1501 Potomac Ave, Biltmore Prods Co Inc ..... LO 3-0808
Port 22 Ore, Box 5766, Tower Equip Co ..... OL 4-1745
Richardson Tex, Box 85, E O Condit
Rich 19 Va, 300 E Main St, W H Kidd & Co 2-9240
St Louis 17 Mo, 8118 Rosalie at Hanley Rd, H B Hale ..... MI 7-2838
San Fran Cal, 420 Mrkt St, Milton S Frank Co ..... YU 2-5405
Tampa 3 Fla, 2509 W Hillsboro Ave, W E Minich & Assoc 71-8871
Tulsa 20 Okla, 1432 E 6th St, Snyder Co Inc ..... GI 7-0126

Moore Company The
K C 12 Mo, 424 Nichols Rd, R D Moore, Pres ..... WE 1-2365

Moran Furnace and Sheet Metal Company
Tulsa Okla, 807 E 5th Pl, W O Moran, Owner ..... CH 2-4104

Morland Associates
Garwood N J, 63 South Ave, Frank D Morris, Pres ..... SU 9-0111

Mueller Company
Decatur Ill, 512 W Cerro Gordo St, A G Webber Jr, Pres ..... DE 3-4471
Dan R Gannon, Genl Sales Mgr
Chattanooga 1 Tenn, 2501 Chestnut St ..... AM 7-1181
L A 23 Cal, 2801 E 12th St ..... AN 8-4193
N Y 1 N Y, 350 Fifth Ave, Rm 1322 ..... LA 4-4394
San Fran Cal, 681 Market St ..... EX 2-5314

Murphy Diesel Company
Milw 14 Wis, 5317 W Burnham, R E Houston, Pres ..... MI 5-2255
Paul Schnetzky, VP
Albuquerque N M, 2601 4th St NW, Lively Equip Co
Bakersfield Cal, 502 S Real Rd, Glenn Rose Eng Serv
Butte Mont, 812 E Iron St, Hall-Perry Machy Co
Corpus Christi Tex, 300 McBride La, Houston Eng & Pump
Dallas 1 Tex, 1311 S Ervay, Conley-Lott-Nichols Machy
Denver 16 Colo, 5300 Colo Blvd, Macdonald Equip Co
Great Bend Kans, Box 484, Manufacturers Supply Inc
Great Falls Mont, 1116 15th St, Hall-Perry Machy Co
Houston 1 Tex, 1939 Cullen Blvd, Houston Eng & Pump Co
Jackson Mich, 921 Mich Ave E, Utility & Ind Supp Co
Lubbock Tex, Box 929, Conley-Lott Machy Co
Odessa Tex Box 2408, Conley-Lott Machy Co
Okla City Okla, Box 4547, Cap Hill Sta, Carson Mach
San Antonio 12 Tex, 1302 E Euclid, Ray Klossner Co
Tulsa Okla, Carson Mach & Supply Co, Daniel Bldg

A B Murray Company Incorporated
Eliz N J, Box 476, A J Murray, Pres ..... EL 4-1200
Geo H Root, Genl Sales Mgr
Bristol Pa, Box 203, Robt Johnson ..... ST 8-9221
McKeesport Pa, Box 405, P S Richards ..... NO 4-4471

N

Nagle Pumps Incorporated
Chi Hts 1 Ill, 1249 N Center St, Perry Nagle, Pres ..... SK 4-2940

Narda Ultrasonics Corporation The
Mineola N Y, 122 Herrics Rd, John McGregor ..... PI 6-4650
Paul Platzman, Sales Mgr

Nash Engineering Company
So Norwalk Conn ..... VO 6-3351
Representatives in Principal Cities

National Airoil Burner Company, Division of Chemical Petroleum
Phila 34 Pa, 1284 E Sedgley Ave, John F Straltz Jr ..... PI 3-5300
W Ferguson, VP-Sales Chemical Petroleum Div
W A Harko, VP-Sales Industrial & Domestic Div
Houston 6 Tex, 2512 S Blvd, Ray Hulmes ..... JA 2-7070

National Aluminate Corporation
Chi 38 Ill, 6216 W 66th Pl, J A Holmes, Pres ..... PO 7-7240
Ann Arbor Mich, 1315 Fountain St, G W Liedholz ..... NO 2-0256
Chagrin Falls (Cleve) O, Box 262, J H Gronbach ..... CH 7-8178
Chi Ill, 6216 W 66th Pl, L Pollet ..... PO 7-7240
Dayton 9 O, 325 Ravenwood Ave, C D Sievertsen WA-7212
Edwardsville Ill, Box 502, R E Towell 1248
Glendale 8 Cal, 3425 Ocean View Blvd, J T Nicholson ..... CH 5-6853
Houston 25 Tex, 1020 Holcombe Blvd, L Robinson ..... JA 8-7695
Indpls 8 Ind, 4994 Olympia Dr, J P Berry ..... CL 1-9513
Jacksonville 11 Fla, Box 8124, T G Cocks ..... RA 4-3834
K C 15 Mo, 9407 High Dr, A F Diehn ..... MI 9-0992
Knoxville 19 Tenn, 704 Cherokee Blvd, C J Sartorius 8-2382
Meadowbrook Pa, Box 224, B J Lamb ..... TU 6-9946
Milw 10 Wis, 2764 N 71st St, I M Ward ..... GR 6-1916
Mobile Ala, Box 85, Crichton Sta, R T Powers ..... GR 7-3981
N Y 17 N Y, 551 Fifth Ave, F N Kemmer ..... MH 7-0545
Pgh 34 Pa, 708 Gypsy Lane, I A Clausen ..... LO 1-2743
S Egremont Mass, Sheffield Rd, R I Moran 730
Tulsa Okla, 1223 E 18th St, J A Rush ..... DI 3-7754

National Carbon Company, Divsion of Union Carbide Corporation
N Y 17 N Y, 30 E 42nd St. ..... MU 7-8000
Representatives in Principal Cities

National Foam System Incorporated
West Chester Pa, Union & Adams Sts, F L Boyd, Pres ..... OW 6-3600
L W Boerner, VP-Sales

National Sales Company, Subsidiary of National Tank Company
Bakersfield Cal, Box 1593, B D Schell ..... FA 2-2270
L A Cal, 330 Comm Exch Bldg, W H Becker VD-1949

National Supply Company The
Pgh 22 Pa, 2 Gateway Center, M E Swain, VP-Sales ..... EX 1-2900
C R Bond, Sales Mgr Production Equip Div
J S Blair, Sales Mgr Drilling Equip Div
R W Gordon, Sales Mgr Mdrg Products Div
T D Herndon, Sales Mgr Oil Field Div
Dallas 21 Tex, Dallas Fed Sav Bldg, A F White
Denver 2 Colo, 1640 Welton St, R D Stottlemyer
Houston 1 Tex, 1426 Commerce Bldg, J W Babb
N Y 20 N Y, 600 Fifth Ave, A R Meyer
Torrance Cal, 1524 Broder Ave, J L Evans
Toledo 6 O, 3320 Bishop St, W D Crawford
Tulsa 20 Okla, 504 E Archer St, K O Hoevel

National Tank Company
Tulsa Okla, Box 1710, Jay P Walker, Pres ..... CH 2-9141
A W Francis Jr, VP-Sales
Abilene Tex, Box 2311, Earl Keck ..... OR 2-8484
Ardmore Okla, Box 746, Morris White 1211
Brookhaven Miss, Box 99, R L Morris 592
Casper Wyo, Box 1367, Jas D Thomas 2-7183
Clay City Ill, Box 286, Charles Purser ..... OR 6-2131
Cody Wyo, Box 68, Paul E Meyer 55
Corpus Christi Tex, 1621 N Port, C W Immel ..... TU 4-9201
Dallas 2 Tex, 905 Dallas Fed Sav Bldg, S S Parker ..... RI 1-6230
Denver 2 Colo, 420 Pet Club Bldg, L F Conley ..... AC 2-4723
El Dorado Kans, Box 202, Clem S Kier 2327
Farmington N M, 102¼ N Court Ave, H D Jones ..... DA 5-2321
Ft Worth Tex, 1224 Fair Bldg, R M Speir ..... ED 2-6981
Great Bend Kans, 7th & Wash St, Sam Mays ..... GL 3-3466
Harvey La, Box 344, W A Todd F146-4237
Hays Kans, 418 E 8th St, H R Hudson ..... MA 4-2315
Hobbs N M, 621 N Grimes, L M Jewett ..... EX 3-6126
Houston 23 Tex, 2417 Gulf Bldg, Ed M Fontaine ..... CA 7-4208
Lake Charles La, Box 436, Neely Lowrie ..... HE 3-3697
Laurel Miss, Box 2355, R S Treadwell 5431
Liberal Kans, Box 882, Geo Powers ..... MA 4-5411
Longview Tex, 809 E Hwy 80, E L Brinkley ..... PL 9-2738
Lubbock Tex, 2023 4th St, M R Willis ..... PO 2-0143
Magnolia Ark, 531 W Calhoun, Geo Steinhaus 634

Advertisement in this issue, index is on page A-6.

COMPANY DIRECTORY

Midland Tex, 133 Cent Bldg, Johnny H Shelton ..... MU 4-6335
Mt Pleasant Mich, 1108 N Kinney Blvd, Jos C Cuthbert ..... SP 3-0251
New Harmony Ind, Box 517, John I Swiney ..... OV 2-4231
New Iberia La, 1127 W Main St, W H Walker ..... EM 4-5476
New Town N D, Box 487, M F Brown ..... MA 7-3512
N Y NY, 600 Fifth Ave, Judd Lowd ..... CI 6-3232
Odessa Tex, 5th & Dixie, Jack C Williams ..... FE 2-6493
Okla City 9 Okla, 543 SE 29th, W E Guin ..... ME 4-0507
Pampa Tex, 832 S Cuyler, Joe L Wells ..... MO 4-3261
Pawhuska Okla, Box 596, Nick Quinalty 1719
Rock Springs Wyo, Box 1012, Geo Pasternak ..... EM 2-6509
San Angelo Tex, Box 1084, O A Claunch 2-1786
Seminole Okla, 1004 N 1st St, Joe Notley 3030
Shreve La, Box 1228, Merle W Bryon 2-0378
Sidney Neb, Box 331, W H Akin 2622
Snyder Tex, Box 613, Geo Stewart 3-4654
Vernal Utah, Box 207, Joe E Blackman 505
Wichita Kans, 406 Union Natl Bldg, Dick Brooks ..... FO 3-1991
Wichita Falls Tex, 700 N Scott St, W R Willis 3-2191
Williston N D, Box 451, E E Griggs 2-2641

National Tube Division, United States Steel Corporation
Pgh 30 Pa, 525 Wm Penn Pl, J E Goble, Pres ..... EX 1-2345
W J McKee, Sales Mgr

National-U S Radiator Corporation, Heat Transfer Division
N Y 17 N Y, 342 Mad Ave, T B Focke, Pres, (Johnstown) ..... MU 2-2974
R A Specht, Mgr Heat Transfer Div (NY)
S E Nelson, Sales Mgr Drayer Hanson Div, L A Cal
R E Leonard, Sales Mgr Cyclotherm Div, Oswego N Y
C E Hanson, Sales Mgr Plastic Metals Div, N Y
R H Kortkaus, Sales Mgr MacGregor Comarain Div, N Y
F S Hudson, Sales Mgr Htg & Air Cond Div, Johnstown
Birm 6 Ala, 5018 First Ave N, D B Gooch ..... LY 2-8191
Chi 3 Ill, 105 W Adams St, F A Faville ..... CE 6-8860
Cinn 11 O, 3311 Harrison Ave, A A Betts ..... HU 1-7577
Clearwater Fla, Box 26, Johnson Roney II 3-1136
Cleve 16 O, 20800 Center Ridge Rd, W W Lige ..... ED 1-3077
Denver 10 Colo, 1449 S Bwy, Jud Manning ..... RA 2-0383
Houston Tex, 8419 Hansen Rd, J L Shaunty ..... HU 4-1110
L A 63 Cal, 3301 Medford St, H L Hunt ..... AN 9-0321
Norberth Pa, 114 Forrest Ave, C B Ives ..... TR 7-9505
N O 15 La, 4020 Thalia St, H A Thompson MA-3885
N Y 17 N Y, 342 Mad Ave, R A Specht ..... MU 2-2974
Odessa Tex, 114 N Wash, S L Stentz 7-3524
Oswego N Y, 157 E First St, F J Garahan 666
Pgh 19 Pa, 501 Alcoa Bldg, D D Foster ..... AT 1-0865
Port Wash N Y, Professional Bldg, J F Lawrence ..... PW 7-6401
S Charleston W Va, 411 D St, D D Foster Jr ..... RI 4-9446

Naylor Pipe Company
Chi 19 Ill, 1230 E 92nd St, N E Turney, Pres ..... SA 1-9400
N Y 17 N Y, 60 E 42nd St, J V McMullan ..... MU 2-2464

✓ **Nelson Electric Manufacturing Company**
Tulsa Okla, 4041 S Sheridan Rd, H A Norberg, Pres ..... RI 2-5531
Carl J Nash, Mgr Marketing Div
Jack L Gates, Agency Sales Mgr
Atlanta 9 Ga, 423 Collier Rd NW, D Glenn Sudderth ..... TR 2-8933
Bay City Mich, 2306 Nurmi Dr, Walter I Foss ..... TW 2-3448
Birm 11 Ala, 1664 Woodland Ave SW, J B Burtchaell ..... ST 5-9509
Buff 21 N Y, 13 S Cayuga Rd, C V Stevens PL-0300
Butte Mont, 604 Utah Ave, T D McGarry 8916
Chi 2 Ill, 900 State Mod Bldg, R S Terhune ..... FI 6-0053
Cinn 6 O, 2425 Gilbert Ave, Joe Pratt ..... CA 1-1283
Cleve 25 O, 4619 E 93rd St Garfield, S J Vereb ..... VU 3-6999
Col 12 O, 1620 W First Ave, Fred Bush ..... HU 8-6343
Dallas Tex, 1008 Fid Un Life Bldg, Wm L Adair ..... RI 8-1140
Denver 16 Colo, 4949 Colo Blvd, Howard Peterson ..... DE 3-5434
Det 35 Mich, 19741 James Couzens Hwy, R C Engel ..... BR 3-9258
El Paso Tex, 511 Hawkins Way, R R Hynes ..... PR 2-3233
Havertown Pa, 237 Wendover Dr, R F Leahy ..... HI 6-7607
Houston 2 Tex, 371 M & M Bldg, Lynn T Elliott ..... CA 4-9715
K C 6 Mo, 832 Law Bldg, M A Boggs ..... VI 2-4197
Mpls 4 Minn, 814 S 9th St, F Klass ..... FE 8-8427
N O 8 La, 1001 St Chas Ave, C Espy Reed ..... JA 2-2703
Okla City Okla, 4201 NW 45th St, R A Fosse ..... WI 2-3130
Phoenix Ariz, 1029 N First St, Dick Barnes ..... AL 8-5281
Pgh 36 Pa, 211 Yarrow Lane, W E Wargo ..... TU 4-3977
Pine Bluff Ark, Box 618, W S Kennedy .....
Port 9 Ore, 935 NW 12th Ave, Frank G Perri ..... CA 8-3798
Ridgewood N J, 51 N Broad St, F M Ballou ..... GI 4-6990
Roanoke 15 Va, 1921 Langdon Rd SW, R W Kraft ..... RO 3-9138
Salt L City 1 Utah, 200 S Main St, F Y Gates ..... EL 9-1101
San Gabriel Cal, Box 38, H J Randolph ..... CU 3-4183
San Fran 5 Cal, 55 New Montgomery St, Oliver B Lyman ..... SU 1-6440
Seattle 9 Wash, 935 NW 12th Ave, Fred W Carlson EL-6630
Springfield 4 Mo, Box 2176 Natl Sta, Ivan Boggs & Co 5-2141
St Louis 9 Mo, 6414-A Hampton Blvd, L L Petefish ..... FL 1-2175

Neptune Meter Company
N Y 20 N Y, 19 W 50th St, D E Broggi, Pres ..... CO 5-3994
R N Wetjen, Sales Mgr Petroleum Div
Atlanta 18 Ga, 200 Permalume Pl NW, R C Lewis ..... SY 4-8215
Boston 16 Mass, 250 Stuart St, W H McGarry ..... HA 6-9123
Chi 74 Ill, 4048 W Taylor St, W P Haendel ..... SA 2-4014
Dallas 7 Tex, 315 Cole St, G W Cissna ..... RI 1-4904
Denver 7 Colo, 3815 Forest St, W H Badley ..... DU 8-1523
N Kans City 16 Mo, 25 W 15th St, I T Collar Jr ..... GR 1-3345
L A 22 Cal, 5540 E Harbor St, H Horandt ..... RA 3-4571
Louisville 17 Ky, 320 Eastern Pkwy, J C Hart ..... ME 5-6389
Millbrae Cal, 101 Rollins Rd, G King Keils ..... OX 7-4477
Phila 2 Pa, 1420 S Penn Sq, R Gumaer ..... LO 4-3170
Port 10 Ore, 2680 NW Thurman St, J C Judge ..... CA 8-0130

New England Tank and Tower Company
Everett 49 Mass, 85 Tileston St, Conrad Pennucci, Pres ..... EV 7-0318
J J Lennon, VP-Sales Mgr
Berkeley Cal, 605 Addison St, D Stiehl ..... TH 3-6826
Chi III, 332 S Mich Ave, H Munday ..... HA 7-4266
Cinn O, Union Term Bldg, R W Steves ..... PA 1-6183
Cleve O, 2036 E 22nd St, S Gerow ..... MA 1-4570
Det Mich, 642 Beaubien St, W Chapman ..... WO 1-0590
Haddonfield N J, Box 144, W Stockdale ..... CO 5-6403
L A Cal, 606 S Hill St, G R Oster VA-1996
Pgh Pa, 1610 Potomac Ave, R Dempler ..... LO 1-4400
Ridgefield N J, 600 Broad Ave, Edwin Storms ..... WH 5-4703
St Louis Mo, 4053 Lindell Blvd, John Sears ..... JE 5-6640
Victor N Y, R Johnsen VI-3141

Nichols Engineering and Research Corporation
N Y 5 N Y, 70 Pine St, C W Nichols Jr, Pres ..... WH 3-5520
R W Rowen, VP-Sales
J I Frankel, Sales Mgr Refuse Incineration Div
Chas F von Dreusche Jr, Sales Mgr Ind Sales Div
Indpls, Ind, 3513 N Hovey St, Mark B Owen ..... WA 5-4222
San Fran Cal, 405 Montgomery St, Frank J Murray Jr ..... DO 2-4386

C W Nofsinger Company and Nofsinger-Long Company
K C 13 Mo, 307 E 63rd St, C W Nofsinger, Pres ..... EM 3-1460
L A 17 Cal, 609 S Grand Ave, A R Chandler MI-5912

✓ **Nooter Corporation**
St Louis 4 Mo, 1400 S Second St, Robert J Ryan, Pres ..... MA 1-6000
Arthur Schwarz, Sales Mgr
N Y 7 N Y, 30 Church St, S N Olliver ..... CO 7-6840

Nopco Chemical Company
Harrison N J, First and Essex Sts, Ralph Wechsler ..... HU 3-6200
W B Morehouse, VP-Sales Mgr Industrial Div
Boston Mass, 10 High St, L E Rossiter
Cedartown Ga, 701 Wissahickon St, J M Gammon
Chi III, 3625 Jasper Pl, R F Spain
N Arlington N J, 175 Schuyler Ave, G G Stier, Vice Pres
Rich Cal, 1141 S 14th St, J E Connell

Norcross Corporation
Newton 58 Mass, 247 Newtonville Ave, Austin S Norcross, Pres ..... DE 2-3410
Buff 17 (Kenmore) N Y, Box 26, Murphy & Morse RI-0463
Chi 4 Ill, 332 S Mich Ave, J B McMahon ..... WA 2-1848
Charlotte N C, Box 9104, R S Davis Jr ..... FR 5-1357
Cinn 12 O, Box 16, Wilcox Engrg Co ..... EL 1-4935
Cleve 29 O, Box 7283, King Instrument Co ..... TU 3-3450
Detroit Mich, 12638 Woodrow Wilson Ave, King Sales ..... TO 8-2123
Houston 19 Tex, 3513 W Dallas Ave, Marshall, Neil & Pauley Inc ..... JA 9-3596
L A 57 Cal, 1919 Beverly Blvd, Jensen Instr Co ..... DU 8-2248
Milw 15 Wis, 4101 W Greenfield Ave, C C Schroeder ..... EV 3-3070
N O La, Box 4116, Marshall, Neil & Pauley Inc WA-4275
Phila 18 Pa, 400 Bethlehem Pike, Penn-Del Instr Sls ..... CH 7-7389
Pgh Pa, Box 10387, King Instr Co ..... LO 1-4208
San Fran 7 Cal, 429 Bryant St, Jensen Instr Co ..... EX 2-1472
Tulsa Okla, Box 4267, Arduser & Co ..... TU 4-2405

Nordberg Manufacturing Company
Milw 1 Wis, 3073 S Chase Ave ..... SH 4-2370
R W Bayerlein, Vice Pres, Engine Div
J G Broz, Sales Mgr Petroleum Div
Dallas 6 Tex, 433 Meadows Bldg, M R Wall ..... EM 8-4644
Houston 2 Tex, 1811 Crawford St, W G Sliffe ..... CA 4-1406
K C 11 Mo, 4528 Main St, J T Adams ..... JE 1-9294
N O 12 La, 124 Camp St, W J Moran TU-5192
N Y 17 N Y, 60 E 42nd St, A R McMullin ..... MU 7-7666
St Louis 18 Mo, 3300 S Second St, R C Gamble ..... PR 6-3050
San Fran 7 Cal, 674 Harrison St, C G Cox ..... EX 2-3305
Wash 6 D C, 609 Barr Bldg, R M Austin ..... NA 8-2343

W C Norris Manufacturer
Tulsa Okla, 10 N Elwood, Wm L Butler, Pres ..... LU 4-4241
D P Hagaman, Sales Mgr
Abilene Tex, 1242 Graham St, K M Cook ..... OR 2-2283
Ardmore Okla, 705 N Maxwell NW, Homer Hill 3452
Casper Wyo, 1323 E "C" St, LeRoy Mitchell 3-4154
Corpus Christi Tex, 811 N Port Ave, J D Bain ..... TU 2-6333
Dallas Tex, 7802 Caillet St, Hamp Brooke ..... FL 7-1167
Denver Colo, Box 995, Bill Forcum ..... FR 7-6957
Ft Worth Tex, 3620 Shelby Dr, W J Whitaker ..... WA 1-1793
Great Bend Kans, W 10th St, C T Fair ..... GL 3-8482
Hobbs N M, 1400 E Pecos, Geo White ..... EX 3-2400
Houston Tex, 6536 Supp Row, John Connell ..... WA 6-1708
Kilgore Tex, 212 Danville, W C Tolleson 2068
Lafayette La, 1501 W Ste Mary's Ave Apt B, W Peterson ..... CE 5-2614
Midland Tex, 706 W Nobles, D W Stewart 4-6434
Odessa Tex, 719 W First, Paul Colvard ..... FE 7-8348
Okla City Okla, 1117 SE 29th, A L Ethridge ..... ME 7-1590
Pampa Tex, 1021 Terry Rd, Dan Coates ..... MO 5-3513
Salem Ill, S Hwy 40, Kenneth Hance 1172
Shreve La, 3508 Reily Lane, T Barron Preslar 85-3288
Tulsa Okla, 10 N Elwood, J E Giles ..... LU 4-4241
Wichita Kans, 1808 Joann, R L Preston ..... WH 3-0611
Wichita Falls Tex, 916 Ohio St, M E McKelvey 3-1551

Norton Company
Worcester 6 Mass, New Bond St, M C Higgins, Pres ..... PI 2-4641
Harlan T Pierpont Jr, Sales Mgr Refract Div
Fred L Curtis, Sales Mgr New Products Dept

Norwood Controls Unit, Detroit Controls Division of American Radiator and Standard Sanitary Corporation
Norwood Mass, 934 Wash St, Joseph M Devine, Genl Mgr ..... NO 7-4010
Michael D Altfillisch

N R C Equipment Corporation
Newton 61 Mass, 160 Charlemont St, Jas H Moore, Mgr ..... DE 2-5800
Harry D Stone, Sales Mgr
Atlanta Ga, 3133 Maple Drive NE, W C Davis ..... CE 3-6346
Boston 61 Mass, 160 Charlemont, T E Burleigh ..... DE 2-5800
Chi 45 Ill, 3555 W Peterson Ave, Byron Ellis ..... IR 8-8676
Cleve 3 O, 4205 Chester Ave, F X Maher ..... HE 1-0963
Houston 6 Tex, 3323 Mercer St, R F Hainge ..... JA 9-2573
Palo Alto Cal, 291 Lambert St, C W Herrmann ..... DA 6-6033
Pasadena Cal, 557 E Walnut St, G E Fuson ..... SY 2-0702
Pgh 37 Pa, 7929 Perry Hwy, P U P Schwab ..... FO 4-2866
Wash D C, 261 Constitution Ave, C C Chinnis ..... ST 3-0656
Westwood N J, 72 Westwood Ave, D D Preis ..... WE 5-5156

Nutter Engineering Company Incorporated
Tulsa Okla, Box 7008 Brookside Sta, I Earl Nutter, Pres ..... HI 6-6672
Houston Tex, 4002 Northfield Lane, C C Pryor ..... JA 2-7515
Tulsa Okla, Box 7265, F M Bartlett ..... RI 2-3821

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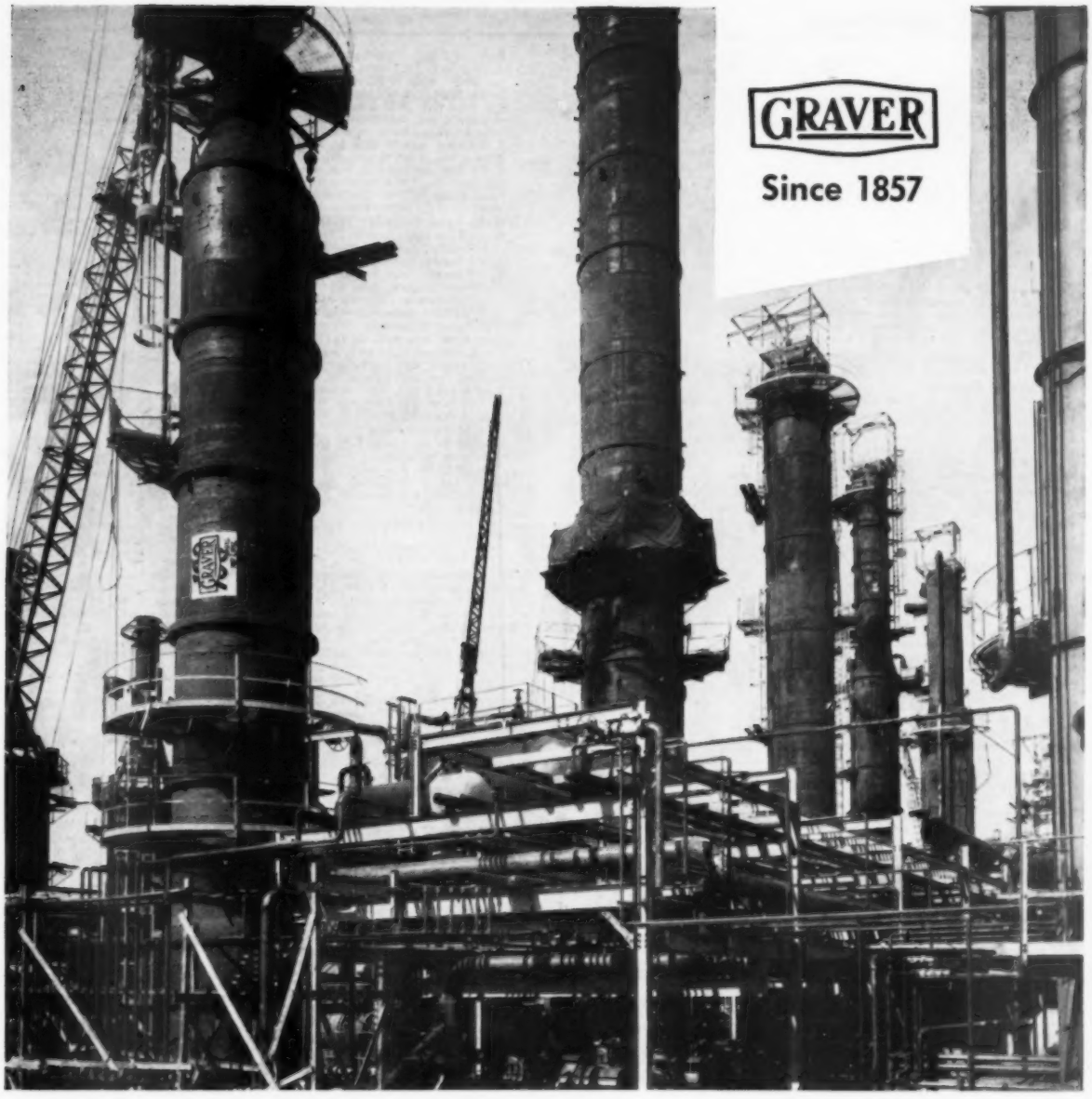

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O

Oakite Products Incorporated
N Y 6 N Y, 48 Rector St, John A Carter, Pres ... WH 3-0940
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R E Tschupp, Sales Mgr Petroleum Serv Div
J D Hudson, Field Mgr Pet Serv Div
Atlanta 3 Ga, 417 Palmer Bldg, S L Perkins ... MU 8-1995
Chi 11 Ill, 400 N Mich Ave, F J McNally ... SU 7-8058
Cleve 14 O, 850 Euclid Ave, F H Bruening ... CH 1-0672
Dallas 1 Tex, 1509 Main St, T C Zimmerman ... RI 7-2589
Det 2 Mich, Genl Motors Bldg, T R Smith ... TR 5-6330
Hartford 3 Conn, 410 Asylum St, R P Jones ... CH 7-8323
K C 11 Mo, 406 W 34th St, F C Weber ... WE 1-6619
L A 12 Cal, 1001 E First St, J C Leonard ... MA 5-1544
Louisville 2 Ky, 839 Commonwealth Bldg, V L Baltzell ... JU 7-1321
Milw 2 Wis, 757 N Bwy, R A Davis ... BR 6-7440
N Y 6 N Y, 19 Rector St, D X Clarin ... WH 3-0940
Phila 2 Pa, 42 S 15th St, E F Connolly ... LO 7-7660
Pgh 28 Pa, 733 Wash Rd, John P Melhado ... LO 1-4611
Roch 4 N Y, 315 Alex St, Walter G Sittman ... BA 5-3377
St Louis 5 Mo, 111 S Bemiston Ave, S C Shank ... PA 5-8200
San Fran 5 Cal, 681 Mrkt St, C S Rankin ... YU 2-6582

Ogden Filter Company Incorporated
L A 29 Cal, 4214 Santa Monica Blvd, H S Ogden, Pres ... NO 2-2116

Ohio Injector Company
Wadsworth O, Main St, Wayne A Young, Pres ... FE 4-1531
G R Winder, VP-Marketing
Chi 6 Ill, 205 W Wacker Dr, R F Dauenhauer ... FR 2-9754
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N Y 17 N Y, 5940 Grd Cent Term Bldg, E L Kinkaide ... MU 9-5278
Phila 3 Pa, 1617 Penna Blvd, P J Gallagher ... LO 7-3777
San Fran 6 Cal, Rm 603 333 Montgomery St, D Gordon ... GA 1-1262

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J E Horner, Sales Mgr Shelby Div
Birm 1 Ala, 1700 Huntsville Rr ... 3-8385
Charlotte 4 N C, 1607 E 7th St ... 6-6382
Chi (Oak Pk) Ill, 6429 West North Ave ... (Chi) AU 7-4717
Cleve 14 O, 1328 Citizens' Bldg ... MA 1-2153
Dayton 6 O, 3740 Salem Ave ... OR -9327
Denver Colo, 5500 Colo Blvd ... KE 4-1241
Det (Ferndale 20) Mich, 520 W Eight Mile Rd ... JO 4-5766
Houston 24 Tex, Box 19111 ... HO 5-5722
L A (Bev Hills) Cal, 170 S Beverly Dr Suite 300 ... CR 6-7614
Moline Ill, 1505 16th Ave ... 2-3693
N K C 16 Mo, 101 E 9th St ... NO -3505
N Y 17 N Y, 70 E 45th St Rm 5620 ... MU 6-3689
Phila 2 Pa, 1905 Packard Bldg ... RI 6-2689
Pgh 16 Pa, 1206 Pinewood Dr ... FI 1-1173
Rich 19 Va, 417 Rich Fed Bldg ... 7-5374
Roch 18 N Y, 410 Brooklawn Dr ... HI -0894
Salt L City Utah, 324 W Eighth South ... DA 2-3533
Seattle 4 Wash, 3102 Smith Tower ... SE -5393
St Louis 10 Mo, 1246 Hampton Ave ... MI 7-1022
St Paul 1 Minn, E-723 First Natl Bk Bldg ... CA 2-1422
Tulsa 3 Okla, 436 Kennedy Bldg ... LU 7-2382
Wichita 1 Kans, 622 E Third St ... AM 5-8686

Oil Equipment Manufacturing Company Incorporated
Louisville 11 Ky, 3100 Vermont Ave, W F Schaetzly ... SP 2-1743
W T Schaetzly, Sales Mgr

Oil Metering and Processing Equipment Corporation
Houston 18 Tex, 4843 Yale St, H V Smith, Pres ... ME 5-1226
Harry D. Holland, Sales Mgr
Representatives in Principal Cities

Oil Well Supply Division, United States Steel Corporation
Dallas 2 Tex, 2001 N Lamar St, F F Murray, Pres ... RI 7-8921
R C Chickering, Genl Sales Mgr

Okadee Company
Chi 4 Ill, 332 S Mich Ave, C G Learned, Exec Vice Pres ... HA 7-6066

Okonite Company The
Passaic N J, 220 Passaic St, R Stuart Keefer, Pres ... PR 7-0400
C M Kirkland, VP-Mrktg Div
Atlanta 8 Ga, 805 Peachtree Bldg Rm 509, J R Hoss ... TR 2-0771
Baton Rouge La, 337 S Arcadian Thruway, O R St John Jr
Birm 5 Ala, Cor 31st St & 7 Ave S, E P Clement ... AL 1-5293
Bluefield Va, Box 509, J P Oblinger ... FA 6-1354
Boston 16 Mass, 1100 Statler Off Bldg, C W Lyons ... HA 6-6080
Chi 29 Ill, 6045 S Knox Ave, E H McNeill ... RE 5-4415
Cinn 8 O, 2904 Woodburn Ave, T J Manning ... AV 1-1350
Cleve 14 O, 620 Engineers Bldg, F J Dahleiden ... PR 1-7171
Dallas 1 Tex, 1011 Tower Pet Bldg, O W Herring ... RI 1-3209
Det 35 Mich, 19960 Jas Couzens Hwy, M A Bergdahl ... VE 8-4348
Houston 2 Tex, 2116 Fannin St, J B Edmonds ... CA 2-9231
Jacksonville 11 Fla, Box 8125, W W Hendrickson ... RA 4-6355
K C 5 Mo, 1004 Balt Ave Rm 202, J R Haden ... GR 1-6991
L A 13 Cal, 427 W 5th St, E Danielson Jr ... MI -9677
Memphis Tenn, Box 3446 Crosstown Bch, W L Wood Jr ... BR 5-1657
Mpls Minn, 6116 St Johns Ave, R W Moore ... FE 6-2979
Mobile Ala, 287 Summit Dr Springfld Sta, J L Booth ... GA 6-9645
N O 12 La, 860 St Charles St, W D Stroud ... RA -0779
N Y 17 N Y, 501 Fifth Ave, J G Darse ... MU 7-0400
Phila 3 Pa, 1158 Suburban Sta Bldg, H L Hosford ... RI 6-8828
Pgh 22 Pa, 1810 Oliver Bldg, J D Fess ... AT 1-1202
Port S Ore, 880 Pittock Block, J B Caldwell Jr ... CA 8-3173
Roanoke 15 Va, 2508 Laburnum Ave SW, J R Early ... DI 2-4316
St Louis 3 Mo, 1410 Shell Bldg, R E Sontag ... CH 1-6043
San Fran 24 Cal, 701 Phelps St, E J Stephens ... VA 4-7474
Seattle 1 Wash, 1904 Third Ave, A D Marcus ... SE -5277
S Miami 43 Fla, Box 734, W G Huber ... FR 9-9769
Syracuse 3 N Y, 216 Burnet Ave, W E Garrigan ... GR 9-5569
Wilkes-Barre Pa, 72 Hazle St, T Aston ... VA 2-1144

O L Olsen Company Incorporated
Houston 3 Tex, 416 Pierce Ave, Olaf la Cour Olsen, Pres ... FA 3-9146

Omega Machine Company, Division of B-I-F Industries Incorporated
Prov 1 R I, 345 Harris Ave, L E Harper, Pres ... GA 1-4302
P A Coffman Jr, Sales Mgr Omega Machine Co
C G Haire, Sales Mgr Proportioneers Inc Div
F W Deutsch, Sales Mgr Builders-Providence Inc Div
Albany N Y, 11 N Pearl, L S Brice Jr ... 3-8839
Berkeley 2 Cal, 1036 Univ Ave, F D Brindel ... TH 1-2157
Buff 14 N Y, 2302 Main St, F A Shaw ... PA -1825
Chi 30 Ill, 6206 N Milwaukee Ave, T R Gregg ... RO 3-4030
Dallas Tex, 4520 N Cent Expwy, E F Morey Jr ... TA 1-9690
E L A 22 Cal, 5430 Jillson St, P Crowley ... RA 3-1235
Houston 6 Tex, 2435 North Blvd, C J Wolfer ... JA 6-1335
Islington Mass, Wash St, R F Kelsey ... DA 6-5690
K C 11 Mo, 406 W 34th St, R W Lindsey ... JE 1-8080
Milw 8 Wis, 1348 N 37th St, H D Bugg ... WE 3-1991
N Y 7 N Y, 20 Vesey St, H M Mautner ... CO 7-0117
Oakmont Pa, 314 Allegheny Riv Blvd, B E Hamlett ... -1814
Phila 44 Pa, 402 W. Chelten Ave, W S Cadell ... VI 8-5100
Wash 11 D C, 6230 Third St NW, D A Wood ... TU 2-9026

O'Neill Tank Company Incorporated
Great Bend Kans, Drawer 771, D J O'Neill, Pres ... GL 3-5443
Ed Nelson, Sales Mgr Denver Colo Region
G L Tooley, Sales Mgr Great Bend Kans Region
D E Burton, Sales Mgr Hays Kans Reg
John W Simpson, Sales Mgr Kimball Neb Reg
L D Hedrick Jr, Sales Mgr Meade Kans Reg
W C Shook, Sales Mgr Wichita Kans Reg

Orbit Valve Company
Tulsa Okla, Box 699, Ed D Ligon, Pres ... LU 4-4761
L E Wallace, Genl Sales Mgr
C J Folger, Mgr Ind Sales
Houston Tex, 407 Velasco St, Ralph H Soape ... CA 8-6623
Long Beach 7 Cal, 3815 Atlantic Ave, Fred P Koenig Co ... GA 4-3834
N Y 36 N Y, 500 Fifth Ave, D T O'Connor (Export) ... BR 9-2236
Odessa Tex, 402 W County Rd, H C Sawyer ... FE 7-2263

O T M Corporation
Houston 24 Tex, 7430 Katy Hwy, J C Bradshaw, Pres ... UN 2-6643
Kenneth H Bradshaw, VP-Genl Mgr
Joe C Smith, Asst Sales Mgr
Dallas Tex, 3150 Quebec, Boyd Supply Co ... FL 2-9741
Denver Colo, A E Arrington
L A Cal,
N O La, Jim Atkinson
N Y N Y,
Odessa Tex, Eugene J Acuff
Tulsa Okla, P F Craver Jr

Oster Manufacturing Company The
Wickliffe O, 1340 E 289th St, T S Bonnema, Pres ... WH 3-3500
R C Baumgartner, Genl Sales Mgr
Lg Is City, N Y, 25-36 Jackson St, H B Van Osten ... ST 4-3841

Owens-Illinois Glass Company, Kaylo Division
Toledo 1 O, Box 1035, C R Megowen, Pres ... FA -6543
Bruce F Trumm, Sales Mgr Kaylo Div

P

Pabco Industrial Insulation Division, Fibreboard Paper Products Corporation
San Fran 19 Cal, 475 Brannan St, J C Voiles Div Mgr ... EX 2-3657
Chi 54 Ill, 13-125 Mdse Mart Plaza, G I Mulvihill ... SU 7-9644
Houston 4 Tex, 4101 San Jacinto, E M Asbury ... JA 8-6739
L A Cal, 4231 E Firestone Blvd, C D Frethy ... LO 4-3241
N Y 16 N Y, 437 Fifth Ave, J W Cordrey ... LE 2-8880
San Fran 19 Cal, 475 Brannan St, R E Bounds ... EX 2-3657

Pace Company The
Houston 17 Tex, 226 Winkler Dr ... MI 4-5361
Partners: R E Payne
W E Askey
W J Service
E L Ekholm

Pacific Pumps Incorporated, Division of Dresser Industries Inc
Huntington Pk Cal, 5715 Bickett St, A R Weis, Pres ... LU 8-2203
A F Canada, VP-Sales Centrifugal Div
G F Graham, Sales Mgr Plunger Pump Div
Baton Rouge La, 11036 Black Oak Dr, G K Broussard ... WA 1-8937
Chi 3 Ill, 79 W Monroe St, A R Hauser ... FR 2-5712
Cleve 3 O, 4500 Euclid Ave, J A Kendall Jr ... EN 1-3773
Houston 10 Tex, 1619 Ovid St, W L Wathen ... CA 8-2331
Huntington Pk Cal, 5715 Bickett St, W E Brown ... LU 8-2203
N Y 17 N Y, 122 E 42nd St, W S Eadie ... OX 7-2800
Phila 3 Pa, 1612 Mrkt St, J A Lundquist ... LO 7-7073
San Fran 5 Cal, 593 Market St, E L Watts ... GA 1-4956
Tulsa 20 Okla, 1221 E First St, W J Bahler ... CH 2-8957

Pacific Transducer Corporation
L A 64 Cal, 11836 W Pico Blvd, R S Clarke, Pres ... GR 8-1134

Pacific Tube Company
L A 22 Cal, 5710 Smithway St, E H Lloyd, Pres ... RA 3-1331
W P Armstrong, Sales Mgr

Pacific Valves Incorporated
Long Beach 7 Cal, 3201 Walnut Ave, Howard Dumm, Pres ... GA 7-5451
Robt C Macaulay, Genl Sales Mgr
John Gryson, Sales Mgr Western Div
Atlanta Ga, 3179 Maple Dr NE, Jack Obrien ... CE 3-7651
Buff 15 N Y, 1132 Kensington Ave, R E Bauman ... AT -2975
Chi Ill, 221 N LaSalle St, John Punch ... ST 2-2824
Cleve O, 20950 Center Ridge Rd, C R Stilwell ... ED 3-1722
Houston Tex, 3602 W 12th St, C Steinberger ... UN 2-8821
N O La, Box 5276, Wm Maclane ... EX -3561
N Y 16 N Y, 22 E 40th St, F Shlemmer ... LE 2-5012
Phila Pa, c/o Woodbury N J OR, Ed Daniels ... WA 2-4241
Pgh Pa, 418 Frick Bldg, W J Bakelman ... EX 1-2461
Rich 24 Va, 5511 Kay Rd, R M Morrison ... 3-5582
Seattle Wash, 2208 White-Henery-Stuart Bldg, H Harman ... MU -4235
San Fran Cal, 1230 Russ Bldg, J Caraway ... GA 1-0194
Tulsa Okla, 301 Midstates Bldg, J Peters ... GI 7-3359
Woodbury N J (Phila), 231 Everett Ave, S Sanard ... TI 5-7100

Packed Column Corporation
N Y 7 N Y, 30 Church St, L B Bragg, Pres ... WO 2-7240

Palmer Thermometers Incorporated
Cinn 12 O, 2501 Norwood Ave (Norwood), ... ME 1-1500
Bartlett Palmer, Pres
Douglas H Hitt, Sales Mgr
Representatives in Principal Cities

Panellit Inc and Panellit Service Corporation
Skokie Ill, 7401 N Hamlin Ave, Albert F Sperry, Pres ... OR 5-2500
Millard D Shriver, V P Sales
T H Gluck, Sales Mgr

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Perce Company Incorporated The
N Y 7 N Y, 136 Church St, ... CO 7-7255
N M Weisser, Sales Mgr Petroleum Div

Parker-Hannifin Corporation, Parker Fittings and Hose Division
Cleve 12 O, 17325 Euclid Ave, S B Taylor, Pres ..... KE 1-3000
D S Manning, Div Mgr
D A Cameron, Genl Sales Mgr
W D Wynant, Div Sales Mgr
Representatives in Principal Cities

Ralph M Parsons Company The
L A 14 Cal, 617 S Olive St, Ralph M Parsons, Pres ..... MA 9-2484
N Y 16 N Y, 10 E 40th St, H P Broom ..... LE 2-3493
Wash 6 D C, 1001 Conn Ave NW, Hilton C Smith ..... DI 7-3300

Partlow Corporation
New Hartford N Y, 208 Campion Rd, Howard W Partlow Jr ..... UT 2-5105
Wayne A McGrew, VP-Sales
H H Janes, Sales Coordinator
Atlanta 5 Ga, 3252 Peachtree Rd NE, deW H Gunsolus ..... CE 3-3812
Birm 3 Ala, 652 Brown Marx Bldg, Genl Combustion Co 54-6863
Buff 17 N Y, Box 56 Kenmore Sta, Earl H Seelbach ..... DE 4- 014
Chi 20 Ill, 8216 S Western Ave, Finn & Conway Inc ..... WA 5-9702
Butler Wis, Box 603, Monroe Engrg Co
Cinn 29 O, 515 Melish Ave, Stelter & Brinck ..... PL 1-0453
Cleve 13 O, 2012 W 25th St, Glatte & Co ..... TO 1-0898
Dallas 25 Tex, 6331 Northwood Rd, Chas A Drum ..... EM 1-2082
Houston Tex, 1307 Jeff Ave, General Instr Co ..... FR -4052
Midland Tex, 2005 W Fla St, Hy-Bon Engrg Co 2-2745
Davenport Iowa, 320 Western Ave, Deco Engrg Prods 7-6123
Des Moines Iowa, 1112 Locus St, Deco Engrg Prods ..... AT 8-5721
Denver 4 Colo, 100 W 13h Ave, Slaybaugh-Thompson Co ..... AC 2-5826
Det 8 Mich, 2591 W Grand Blvd, Oliver Stirling Inc ..... TR 5-6300
Fargo N D, 1017 4th Ave N, Dakota Elec Supp Co
Greensboro N C, Box 5121, J L Paradis ..... GR 4-1501
Indpls 20 Ind, 6220 College Ave, Young-Streeter Co ..... CL 5-5416
Irvington N J, 26 Mt Vernon Ave, W F Wright ..... ES 3-6155
(NYC) BA 7-4160
K C Mo, 4638 Nichols Pkwy, Brandwine Equip Co ..... LO 1-1666
L A 22 Cal, Box 22019, Pacific Scientific Co ..... LU 3-1121
Memphis 5 Tenn, 216 N Lauderdale Ave, C J Gaskell Co 8-2241
Miami 32 Fla, 1221 Biscayne Blvd, Fla Prec Instr Corp ..... FR 1-0105
New Haven Conn, Box 1944, Etter Engrg Co ..... AT 8-1115
N O 18 La, 7924 Maple St, Frank P Fischer Engrg Co ..... WA -4040
N Y N Y, Alvin M Stock Inc ..... BA 7-4380
Phila Pa, 11 W Ave Wayne Pa, O J Craig ..... WA -4838
Pgh 6 Pa, 115 S Highland Ave, Woessner-McKnight Co ..... EM 1-2900
Port 14 Ore, 1218 SE 7th Ave, Pacific Scient Co ..... FI -9747
Prov R I, Box 94 Cranston RI, Geo M Brenckle Jr ..... ST 1-5410
St Louis 17 Mo, 1700 Big Bend Blvd, Brandwine Equip ..... ST 1-6432
Salt L City Utah, 323 W 14th S, Control Equip Co ..... HU 4-6011
San Fran 7 Cal, 25 Stillman St, Pacific Scient Co ..... DO 2-0934
Seattle 8 Wash, 421 Mich St, Pacific Scient Co ..... MO -7000
Tampa Fla, 424 S MacDill Ave, Ind Spec Sales ..... TA 8-1237
Union N J, 2801 Central Ave, Alvin M Stock Inc ..... UN 4-2140
Waltham Mass (Boston) Box 47, Ford R. Waugh ..... TW 3-8658

Patent Scaffolding Company Incorporated
Long Is City 1 N Y, 38-21 12th St, V W Meng, Pres ..... EX 2-3660
Atlanta 3 Ga, 38 Haynes St NW ..... MU 8-7210
Balt 30 Md, 1533 Ridgely St ..... MU 5-2805
Boston 19 Mass, 20 Howard St ..... HI 5-1133
Charlotte N C, 2542 Lucena St ..... ED 4-5381
Chi 22 Ill, 1550 Dayton St ..... MO 4-2200
Cleve 13 O, 2501 W 3rd St ..... PR 1-3397
Dallas 8 Tex, 2200 Singleton Blvd ..... FE 1-5403
Det 12 Mich, 9030 Lumpkin Ave ..... TR 3-1313
K C 6 E Mo, 1520 Truman Rd ..... HA 1-3480
L A 1 Cal, 6931 Stanford Ave ..... PL 3-2571
Miami 50 Fla, 7140 N Miami Ave ..... PL 4-9565
Milw 2 Wis, 135 E Pgh Ave ..... BR 2-2712
Newark 12 N J, 429 Frelinghuysen Ave ..... BI 8-2340
Newington Conn, 2545 Berlin Turnpike ..... MO 6-0211
N O 18 La, 8000 Edinburgh St ..... AU -0806
Long Is City 1 N Y, 38-21 11th St ..... ST 4-4680
Phila 37 Pa, 2835 Bridge St ..... PI 3-5100
Pgh 12 Pa, 1254 Voskamp St ..... CE 1-6407
St Louis 14 Mo, 6168 Bartmer Ave ..... PA 5-5455
San Fran 3 Cal, 1695 Mission St ..... HE 1-4278
Seattle 9 Wash, 420 8th Ave N ..... SE -7142

Patterson-Kelly Company Incorporated The
E Stroudsburg Pa, Frank L Patterson Jr, Pres ..... ST - 820
Olaf J Pedersen, Genl Sales Mgr
C E Drake, Sales Mgr Heat Exchanger Div
John J Fischer, Sales Mgr Process Equip Div
Donald Rayburn, Sales Mgr Pre-Krete Div
Boston 16 Mass, 96-A Huntington Ave, I B Kelley ..... KE 6-1512
Milw 3 Wis, 2040 W Wis Ave, Geo A Adlam ..... DI 2-8782
N Y 17 N Y, 101 Park Ave, L F Lowe ..... MU 3-8373
Oak Park Ill, 6641 W North Ave, John A Clark ..... ES 8-3026
Phila 3 Pa, 1700 Walnut St, T J Kaunders ..... PE 5-4950

Tod Pazdral Pipeline Specialties
Houston 6 Tex, 2525 S Blvd, Tod Pazdral, Owner ..... JA 2-1403
Jack L. Duke, Sales Mgr
Decatur Ga, 3632 San Jose Dr, Jack Pelkey ..... BU 9-3578
W Monroe La, 213 Chickasaw Dr, Jerry Johnson 2-0151

Peerless Electric Company The
Warren O, 1401 W Mrkt St, Ralph Kroehle, Pres 3155-1
J A Kutz, Sales Mgr
Birm Ala, 1028 7th Ave S, R S Morrison ..... FA 3-1559
Chi 34 Ill, 3405 N Harlem Ave, H C Hohmann ..... PA 5-8758
Cinn 24 O, 5773 Belmont Ave, F M Donnelly ..... LI 2-2727
Cleve 15 O, 2536 Euclid Ave, R L Matthews ..... SU 1-6422
Dallas 26 Tex, 3015 Taylor St, Peabody Brothers ..... RI 7-4801
Drexel Hill Pa, 4812 Drexel Brook Dr, A R Rinda ..... CL 9-3232
Grd Rpds 8 Mich, 6 28th St SE, C H Larson ..... CH 5-3730
Hartford Conn, 119 Ann St, R W Best ..... CH 7-7568
Hickory N C, Box 1670, R B Hamilton 4-2246
Houston 2 Tex, 240 Shea Pl, Peabody Brothers ..... FA 3-8385
Indpls 20 Ind, 6208 College Ave, McNay-Dunn Co ..... CL 1-0860
K C 11 Mo, 34th & Bwy, Vene D Fry ..... JE 1-4615
L A 21 Cal, 1132 E 12th St, Hoyt & Sweet TU-3169
Miami 38 Fla, 561 NE 79th St, Larry Johnson Assoc ..... PL 7-2771
Mpls 4 Minn, 338 E Franklin Ave, A C Jacobson ..... FE 6-1805
N O La, Box 524, Peabody Brothers CR-2181
N Y 17 N Y, 122 E 42nd St, F W Merkel ..... OX 7-3180
Roch 4 N Y, 1152 Sibley Tower Bldg, H K Morrow ..... BA 5-6691
Toledo 2 O, 1118 Madison Ave, C R Reynolds ..... CH 1-2101
Tulsa 14 Okla, 2438 E 21st St, Peabody Brothers ..... RI 2-1704
Wash 6 D C, 723 Mills Bldg, I M Day Co ..... ST 3-2982

Peerless Manufacturing Company
Dallas 20 Tex, 2811 Walnut Hill La, Laura B Sillers, Pres ..... FL 2-8431
John C Thompson, Sales Mgr
Atlanta Ga, 3166 Maple Ave NE, Jack M Smither & Co ..... CE 7-6378
Boston Mass, 201 Devonshire St, T F Fitzgerald ..... HA 6-0790
Buff N Y Box 215 Williamsville Br, Bass Ind Equip Co PL-0600
Chi III, 5717 N Elston Ave, Nielsen & Fryer Inc ..... NE 1-1824
Corpus Christi Tex, 509 Oil Ind Bldg, Smith-Goodenough ..... TU 3-6270
Dallas Tex, 2535 Farrington St, MechanEquip Inc ..... RI 2-2651
Denver Colo, 504 Mining Exch Bldg, Davis and Davis ..... AL 5-3418
El Paso Tex, 611 N Campbell, Geo B Thomson Co ..... KE 3-9503
Houston Tex, 3711 Clinton Dr, Maint Engrg Corp ..... CA 2-2351
K C Mo, 3249 Roanoke Rd, Allan Edwards Inc ..... WE 1-1566
Lg Beach Cal, 3815 Atlantic Ave, Fred P Koenig Co ..... GA 4-3834
Louisville Ky, 2416 Frankfort Ave, H W Severance ..... TW 5-2144
Narberth Pa, 114 Forrest Ave, Ives Equip Corp ..... TR 7-9505
N O La, 1500 Tchoupitoulas St, Coastal Engrg Corp EX-2194
N Y NY, 41 E 42nd St, Malcolm W Black & Co ..... MU 7-2960
Oakland Cal, 3871 Piedmont, Barth Engrg Co ..... OL 3-8740
Odessa Tex, 420 E 2nd, Beal Equip Co ..... FE 2-6412
Pgh Pa, 608 Farmers Bk Bldg, Kerr Eng Sales Co ..... GR 1-6549
Rich Va, 300 E Main St, W H Kidd & Co ..... MI 8-9240
Seattle Wash, 539 1st Ave S, NW Ind Serv Corp EL-6116
Shreve La, Box 175, Maint Engrg Corp 3-2387
Tulsa Okla, 2445 S Jackson St, Allan Edwards Inc ..... DI 3-7184
St Louis Mo, 4903 Delmar Blvd, Week Engrg Corp ..... FO 7-0400
Wichita Falls Tex, 102 Ohio St, Prod Equip Prods Co 2-5717

Peerless Pump Division, Food Machinery and Chemical Corporation
L A 31 Cal, 301 W Avenue 26, G F Twist, Vice Pres-Div Mgr ..... CA 1-3151
E W Lundy, Sales Mgr Peerless Pump Div
Albuquerque N M, 1400 N Bwy, A M Maurer 3-7671
Bakersfield Cal, 127 E 18th St, H B Stanford 4-9819
Chi 4 Ill, 53 W Jackson Blvd, W T Harman ..... WA 2-1147
Decatur Ga, 153 Grove Place, C C Cook ..... DR 7-2667
Denver Colo, 1936 Market St, S W Devoe ..... AM 6-0115
Fresno Cal, 1755 Bwy, E H Hansen ..... AD 3-1241
Indpls 8 Ind, 2005 Northwestern Ave, Gene D Sickert ..... WA 5-9661
L A 31 Cal, 301 West Ave 26, R H Hult ..... CA 1-3151
Lubbock Tex, 2307 Clovis Rd, W E Griffin ..... PO 1921
Merced Cal, Box 869, G H Prather ..... RA 2-1632
Muleshoe Tex, Box 1027, J E McVickers
N Y 5 N Y, 37 Wall St, R P Young ..... DI 4-4350
Plainview Tex, 23rd & Columbia, J K Childress ..... CA 4-5581
St Louis 7 Mo, 2850 N Grand, E G Leipold Jr OL-0802
Visalia Cal, Mineral King Blvd & 3rd Ave, T Berry ..... BE 4-4202

Penberthy Manufacturing Company, Div of Buffalo-Eclipse Corp
Det 10 Mich, 1242 Holden Ave, Joseph C Walker, Pres ..... TR 5-0900
Howard Strohmaier, Sales Mgr Penberthy Mfg Div
Representatives in Principal Cities

Pennsalt Chemicals Corporation, Industrial Division
Phila 2 Pa, 3 Penn Center, Geo R Lawson, Dir of Mrktg ..... LO 4-4700
Geo D Grogan, Sales Mgr
Chi 4 Ill, 141 W Jackson Blvd, P C Staples ..... WE 9-2540
Det 26 Mich, 535 Griswold St, E G Warren ..... WO 1-8051
L A Cal, 906 E 3rd St, Martin Hoyt & Milne MI-9878
N Y 22 N Y, 400 Park Ave, C A McCloskey ..... PL 3-7900
Phila 2 Pa, 3 Penn Center, E M Wilson ..... LO 4-3852
Pgh 19 Pa, 425 6th Ave, W P Snelsire ..... AT 1-5233
St Louis 5 Mo, 10 S Brentwood Blvd, D W Graham ..... PA 5-8390

Pennsylvania Pump and Compressor Company
Easton Pa, Ellis R Snavel, Pres 3-4276
Wm E Anderson, Sales Mgr
Akron O, 310 W Exch, J W Gorham ..... FR 6-4514
Atlanta 3 Ga, 120 Houston St NE, Chandler Machy Co WA-3843
Birm 3 Ala, 617 N 9th St, Equip Serv Co 54-4439
Boston 10 Mass, 113 Broad St, Gustavo Preston Co ..... HA 6-3995
Buff 21 N Y, Box 105 Wmsville P O, J G Peterson Co CI-1274
Chattanooga 1 Tenn, Box 1066, Dwight L McNulty 7-4125
Chi 3 Ill, 105 W Adams St, Faville-LeValley Corp ..... CE 6-8860
Cinn 11 O, 3311 Harrison Ave, A A Betts Co ..... HU 1-7577
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Dallas 1 Tex, 3002 Commerce St, Harold O Knape & Co ..... RI 7-7596
Dayton 2 O, Bacon & McDonough Sts, C H Gosiger Mach FU-5174
Denver 1 Colo, Box 591, Ambler Co ..... TA 5-8885
Det 35 Mich, 19951 Jas Couzens Hwy, DuBois-Webb Co ..... BR 3-0880
Greensboro N C, Box 1261, Chas M Swart 2-3174
Hamden 18 Conn, 113 Wayland St, Jas C Burke ..... CH 8-2889
Hoboken N J, 77 River St, George Fendler ..... HO 4-0100
Houston 2 Tex, 1002 Esperson Bldg, H L Thompson Co ..... CA 7-1140
Huntington 17 W Va, Box 2074, H H Truitt Co 3-7832
L A 21 Cal, 2020 Sacramento St, Drlg & Ming Equip Co TR-3401
Milw 12 Wis, 3253 N Green Bay Ave, Dyke & Tutsch Co ..... FR 4-3128
Mpls 4 Minn, 1011 Fifth Ave S, Standard Supp Co ..... FE 5-3196
N O 22 La, 6027 Chathan Dr, David B Fried Jr EV-1052
Phila Pa, 1612 Mrkt St, H K Ball ..... RI 6-5531
Pgh 5 Pa, 11 W Prospect Ave (Ingram), Tutein Equip Co ..... WA 1-7900
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Seattle 4 Wash, 1757 First Ave S, A H Cox & Co MA-1121
S Port Me, 808 Bwy, Burleigh W Loveitt (Boston Branch)
Tampa Fla, Box 803, Mark J Anderson Co 61-5112
Wash 6 D C, 720 Mills Bldg, Meloney Engrg Co ..... DI 7-6329
W Barrington R I, 246 Wash Rd, James K Boyd

Perco Division, Phillips Petroleum Company
Bartlesville Okla ..... Ext 7446 — 6600

Perkin-Elmer Corporation
Norwalk Conn, Main Ave, Richard S Perkin, Pres ..... VI 4-2422
Paul C Hutchinson, Sales Dir Instr Div
J D Winninghoff, Sales Dir Eng & Opt Div
E W Dunstan, Genl Mgr Varnistat Div

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C G Buettman, Sales Mgr Ind Waste Treatment Div
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Ridgewood N J, 10 Wilsey Sq, R J Niznan ..... GI 5-2030
Roch 18 N Y, 375 Glen Ellyn Way, A F McCormack Jr ..... HI 5-2169
St Louis 8 Mo, 3903 Olive St, J W Shoop ..... JE 3-3195
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Spokane 4 Wash, S 180 Wash St, Bumstead & Woolford MA-5514
Wash 4 D C, 918 F St NW Rm 609, J C Tracey ..... NA 8-9173

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Chi Ill, Faville-LeVally
Denver Colo, G M Wallace & Co
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L A Cal, Lester Oberholtz
Phila Pa, Turbex
Pgh Pa, D D Foster Co
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Tulsa Okla, Wm H Mason Co

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L C Waterman, Sales Mgr
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W K Mellon, VP-Cal Div Mgr
R L Pettefer, Sales Mgr Cal
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Toledo 9 O, 1514 Bdwy ..... CH 2-2765

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Atlanta 3 Ga, 903 Candler Bldg ..... MU 8-2322
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Chi 3 Ill, 100 W Monroe St ..... FR 2-6336
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Greensboro N C, Box 2643 ..... GR 3-0257
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K C 11 Mo, 406 W 34th St ..... VA 1-1265
L A 22 Cal, 6100 Garfield Ave ..... PA 1-1191
Memphis 1 Tenn, 903 Union Planters Natl Bk Bldg ..... JA 5-7726
Milw 11 Wis, 2408 N Farwell Ave ..... BR 1-1232
Mpls 16 Minn, 110 Excel Bldg ..... WA 6-2795
N O 12 La, 1009 Carondelet Bldg MA-1191
Phila 32 Pa, 3105 W Allegheny Ave ..... BA 5-6600
Pgh 22 Pa, 1532 Oliver Bldg ..... EX 1-1550
Port 9 Ore, 1436 NW 16th Ave ..... CA 6-6117
Rich 21 Va, 1000 Thompson St ..... EL 5-6521
Roch 7 N Y, 75 College Ave ..... GR 3-9230
St Louis 3 Mo, 1221 Locust St ..... CH 1-4110
San Fran 4 Cal, 369 Pine St ..... EL 2-7379
Seattle 1 Wash, 505 Skinner Bldg ..... MA 3-6790
Wash 4 D C, 207 Natl Press Bldg ..... NA 8-8446

Philadelphia Gear Works Incorporated
Phila Pa, Erie & G Sts, R C Ball Sr, Pres ..... RE 9-6602
Howard Murray, Sales Mgr
Balt Md, 4109 Westview Rd, J F Ottinger ..... HO 7-1345
Chi 6 Ill, 20 N Wacker Dr, E Conway Thompson ..... ST 2-9464
Cleve O, 6333 York Rd, W K Kozel ..... TU 6-2522
Houston 2 Tex, 4902 Travis St, Sterling F Womack ..... JA 6-2727
Lynchburg Va, 800 Kemper St, Jas C Stewart ..... LY 7-2763
N Y NY, 330 W 42nd St, C W Ludlow ..... BR 9-4969
Pgh Pa, 418 Frick Bldg, Geo Nairn Jr ..... AT 1-4056

Philco Corporation, Government and Industrial Division
Phila 44 Pa, 4700 Wissahickon Ave ..... TE 9-4000
Henry Argento, Vice Pres
M A Williams, Genl Sales Mgr G & I Div
H E Taylor Jr, Sales Mgr Industrial Prods
F Langstroth, Sales Mgr Government Prods Div
C Pond, Sales Mgr Computers Div
Dallas 35 Tex, 100 Exch Pk N, Richard Howes ..... FL 1-0740
Dayton O, First & Ludlow Sts, John W Kinnally MI-6578
Colo Springs Colo, 1422 N Hancock St, D J O'Rear ..... ME 2-3559
L A 25 Cal, 10589 Santa Monica Blvd, C M Volkland ..... BR 2-1679
Redwood City Cal, 806 Chestnut St, John Campbell ..... EM 9-2921
Wash 6 D C, 744 Jackson Pl N W, Geo Swaney ..... EX 3-1500

Pioneer Industrial Company
Pasadena Tex, 120 Bearle St, H W Finney, Pres ..... GR 2-4388
J M Joseph, VP-Sales Mgr

Pipe Line Development Company The
Cleve 2 O, 5700 Detroit Ave, J R Smith, Pres ..... AT 1-3233

Pipe Linings, Division of American Pipe and Construction Company
Wilmington Cal, 2414 E 223rd St, Robt C Sargent, Div VPNE 6-1771
V L Greedy, Sales Mgr

Pitt-Consol Chemical Company, Subsidiary of Pittsburgh Consolidation Coal Company
Newark N J, 191 Doremus Ave, Jos Pursglove Jr, Pres ..... MA 3-3800
Benjamin W Jones, Sales Mgr

Pittsburgh Coke and Chemical Company, Protective Coatings Div
Pgh 19 Pa, 20th Fl Grant Bldg, Arthur E Gray, Div Mgr ..... AT 1-2290
John H Caldwell Jr, Sales Mgr Prot Coatings Div
Glendale 5 Cal, 223 E Bwy, Wm Saunders ..... CH 5-1228
Houston 19 Tex, 3115 Buff Dr, Murray Ellis ..... JA 3-8351
N Y 17 N Y, 485 Lex Ave, Howard Trusler ..... OX 7-9050
Summit Ill, 7750 W 61st Pl, Henry Schmid ..... (Chi) — LU 2-2650

Pittsburgh Des Moines Steel Company
Pgh 25 Pa, Neville Is, J E Jackson, Pres ..... FE 1-3000
T W Fauntleroy, Genl Sales Mgr All Divs
F Warrington, Sales Mgr (Plate) Midwest Div
F W De Klotz, Sales Mgr Western Div
Atlanta 5 Ga, 361 E Paces Ferry Rd NE, J E Sumpter ..... CE 7-3779
Chi 3 Ill, 690 First Natl Bk Bldg, H M Howard ..... ST 2-2252
Dallas 1 Tex, 1215 Praetorian Bldg, W F Hoffman Jr ..... RI 2-4524
Denver 2 Colo, 323 Railway Exch Bldg, Dale E Ginn ..... MA 3-1018
El Monte Cal, 3240 N Durfee Ave, R C Boss ..... CU 3-4781
Fresno Cal, 346 "G" St, C C Buckley ..... FR 4-4651
Newark 2 N J, 1703 Military Pk Bldg, C R Ford ..... MA 3-3254
Seattle 1 Wash, 500 Wall St, Suite 305, J B Conyers MU-6878
Stockton Cal, 348 N Harrison St, Frank Hanway ..... HO 6-5151

Pittsburgh Lectrodryer Division McGraw-Edison Company
Pgh 30 Pa, Box 1766, G L Simpson, Div Pres ..... GR 1-8782
R H Kearnes, Sales Mgr Engrg Div
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Houston 7 Tex, 7020 Katy Rd, G J Duesterberg, Pres ..... UN 9-3611
H M Kellog, Exec VP-Sales
Cordell Garner, Sales Mgr Tubular Coating Div
E Wilton Perry, Sales Mgr Rubber Lining & Plastic Ctg Div
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Harvey La, First St, Fred O'Rourke ..... FI 1-1636
Odessa Tex, 300 W 61st St, Robt Booth ..... EM 6-4491

Podbielniak, Inc
Chi 11 Ill, 341 E Ohio St ..... SU 7-7825

Poling and Bacon Construction Company Incorporated
Youngstown 14 O, 12124 S Avenue, Steve Bacon, Pres ..... KI 9-2578
Walter F Fisher, Sales Mgr General and Piping Divs

Pona Engineers Incorporated
Houston Tex, 8 Chelsea Pl, C Shults Faulkner ..... JA 6-2788

H K Porter Company Incorporated, W-S Fittings Division
Roselle N J, Box 95, Jackson Kemper, Vice Pres ..... CH 1-1600
Carl J Siebert Jr, Genl Mgr
James H Wyres, Sales Mgr
Anaheim Cal, 630 Amboy St, J C Dilworth ..... KE 5-5474
Atlanta Ga, 267 E Paces Ferry Rd, J E Tough ..... EX 5420
Chi Ill, 228 N LaSalle St, W A Fitzmaurice ..... RA 6-3238
Houston Tex, 914 Main, S E Holm ..... CA 8-4625
Louisville Ky, Republic Bldg, W W Costello ..... JU 2-2661
N Y NY, Box 95, J E Ocello ..... CH 1-1600
Phila Pa, 1443 Land Title Bldg, C G Liberg ..... RI 6-4454
Pgh Pa, 83 Northway Dr, B R Molitor ..... FO 4-8353
Seattle Wash, 501 Jones Bldg, W J Osborn Jr MA-3496
Tulsa Okla, Box 4073, P A Smith ..... LU 2-5538

Potter Aeronautical Corporation
Union N J, Route 22, David M Potter, Pres ..... MU 6-3010
Irving Hirsch, Sales Mgr
Atlanta 5 Ga, 254 E Paces Ferry Rd NE, Charles Vaughn CH-4719
Dayton 10 O, 3898 Linden Ave, P W McRaven KE-1181
Denver Colo, 2364 E Third Ave, Jerry Stevens ..... EA 2-6062
Malibu Cal, 3011 Malibu Canyon Rd, Stuart Betzinger ..... GL 6-8086
Phila Pa, 1436 Land Title Bldg ..... RI 6-9995
Okla City 2 Okla, 815 Midwest Bldg ..... CE 2-3932

Potter Instrument Company Incorporated
Plainview N Y, Sunnyside Blvd, John T Potter, Pres ..... OV 1-3200
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Boston 85 Mass, 221 Grove St S Braintree, R W Bordewieck ..... VI 3-0845
Chi 44 Ill, 5681 W Lake St, R Edward Stemm ..... ES 9-2700
Cleve 32 O, 27190 Forestview Rd, Bill Teplitz ..... RE 1-5676
Cocoa Beach Fla, Stoddard Bldg, DBM Research Corp CB-2438
Dayton O, 3543 Cornell Dr, Harvey Teplitz OR-9178
Ferndale Mich, 109 E Nine Mile Rd, Electro-Mec Assoc ..... LI 7-1422
Huntington Sta N Y, Box 164, Edw Nelson ..... WA 1-5095
La Canada Cal, Box 63, H W Ruby & Assoc ..... SY 0-3195
Mpls 16 Minn, 6110 Excelsior Blvd, Fred B Hill Co ..... WE 9-6727
N Y 36 N Y, 33 W 42nd St, Frathom Co (Export Exc Can) ..... BR 9-9422
Nutley N J, Box 68, Geo Landfear ..... NU 2-6846
Phila 18 Pa, Box 4383, John K Thomas ..... CH 8-2563
Ridgewood N J, 210 S Broad St, G Curtis Engle & Assoc ..... GI 4-1400 (NYC) — RE 2-0091
Ridgewood N J, 210 S Broad St, Mag-Tran Sales Corp
Schenectady N Y, Box 1067, The Redford Corp ..... EX 3-3061
Silver Springs Md (Wash DC), 8415 Georgia Ave, EFI Agy ..... JU 5-3141
Valley Stream L I NY, 66 W Merrick Rd, Dick Holmes ..... VA 5-1711

Wm Powell Company
Cinn 22, Ohio, 2525 Spg Grove Ave, M Forker, Pres ..... DU 1-4600
James Coombe, Chr of Bd & Sales Mgr

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Phila 30 Pa, 1434 Brandywine, Robt A Balderson, Pres ..... RI 6-6671
Carl H Waser, Sales Mgr
Balt 18 Md, 2301 N Charles, R A Reitz ..... BE 5-4161
Boston 61 Mass, 50 Needham Ntn Highlds, R S Lee ..... DE 2-4737
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Charleston 30 W Va, Rm 33 N Bldg, R Moses ..... DI 2-2151
Charlotte N C, Box 1011 J Highsmith ..... FR 5-6436
Chi 4 Ill, 332 S Mich Ave, J B McMahon ..... WA 2-1848
Cinn 2 O, 427 Temple Bar Bldg, E Roy Myers DU-7783
Cleve 14 O, 8301 Pearl Rd (Strongsville) W M Wilson ..... BE 4-5415
Denver 17 Colo, Box 5510, C L Johnson ..... TA 5-0251
Det 4 Mich, Box 517, D Burgess ..... TE 4-5770
Houston 17 Tex, Alpha Engrg Co, I K Farley ..... MI 9-8071
K C 13 Mo, 1735 Locust St, K Campbell ..... VI 2-2315
Kingsport Tenn, Box 627, C Palmer ..... CI 6-8581
L A 22 Cal, 5416 E Beverly Blvd, G D Pribble ..... RA 3-2313
N O La, Box 9275 Metairie, R L Williams ..... VE 5-9417

Preagle, Dukler & Crump
Houston 4 Tex, 5417 Crawford St ..... JA 4-6777

Pressed Steel Company
Wilkes Barre Pa, Box 628, J H MacVeigh, Genl Mgr ..... VA 2-4128
Robt Rioiski, Sales Mgr Petro-Chemical Div
Chi 6 Ill, 913 Rush St, E M Prior ..... SU 7-4424
Det 2 Mich, 503 Curtis Bldg, Clare Charron ..... TR 5-7633
L A 13 Cal, 417 S Hill St, W F Huff ..... MA 6-4855
N Y 17 N Y, 51 E 42nd St, W B Crane Jr ..... MU 2-7126

J F Pritchard and Company, J F Pritchard and Company of California
K C Mo, 4625 Roancke Pkwy, J F Pritchard, Pres ..... JE 1-9500
Karl E Johnson, VP-Genl Mgr, California Div
H Arthur Martin, Exec VP-Sales
H M Low, VP-Sales Power Div
E E Frye, VP-Sales Petroleum Div
W W Doschner, VP-Sales Chemical Div
A R Young, VP-Sales Natural Gas Div
H R Oglesby Jr, VP-Genl Mgr Municipal Serv Co
Chi 6 Ill, 35 E Wacker Dr, W W Bodle, Constr Divs ..... DE 2-4896
Chi 6 Ill, 35 E Wacker Dr, R S Brent, Equip Div ..... DE 2-4896
Houston 25 Tex, Box 20001, R E Bradley, Constr Divs ..... MO 4-3445
Houston 25 Tex, Box 20001, G R Kritzer, Equip Div ..... MO 4-3445

Procon Incorporated
Des Plaines Ill, 1111 Mt Prospect Rd, Carl B Whyte, Pres ..... VA 4-3171
Wm H Gross, Sales Mgr Refinery Div

Proportioneers Inc
See B-I-F Industries, Inc

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G R Raider, Mgr Lighting & Rotary Equip Div
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R Geocaris, Mgr Multi-Vent Div
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Omaha Neb, City Natl Bk Bldg, J H Hutchings AT-2783
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Pgh Pa, 235 4th Ave Rm 717, J P Wayman ..... GR 1-3193
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St Paul 1 Minn, 1608 Pioneer Bldg, R L Mlazgar ..... CA 2-4631
Milbrae Cal, 33 Bwy, J Hess ..... FE 5-4200
Seattle Wash, 1138 Poplar Pl, M V Hickey FR-3777
Syracuse 3 N Y, 753 James St, G J Loewe ..... GR 4-5072
INDUSTRIAL MFG REPRESENTATIVES
Albuquerque N M, 4716 Trumbull SE, R B Black 5-9625
Atlanta Ga, 144 Walker St, G R Koeln ..... MU 8-7077
Denver Colo, 211 Wazee Mrkt, Sales Engrs ..... AC 2-4893

Pyrene-C-O-Two Division, The Fyr-Fyter Company
Newark 1 N J, Box 750, J Dunleavy, VP-Genl Mgr ..... BI 8-2200
M W Tromanhauser, VP-Sales Mgr Pyrene-C-O-Two Div
I Du Breuil, VP-Systems Mgr C-O-Two Systems Div
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Dallas 35 Tex, 8115 Sovereign Row, R A Gustafson
Det Mich, 187 W Grand Blvd, James West
San Fran Cal, 132 Hawthorne St, R W Adams

Pyrometer Instrument Company Incorporated The
Bergenfield N J, 92 Port Ave, A Ballerman, Vice Pres ..... DU 4-5140
Balt 18 Md, 2301 N Chas St, R A Reitz ..... BE 5-9525
Bay Village O, 27005 Knickerbocker Rd, C H Joy ..... TR 1-5900
Birm Ala, 401 Brown Marx Bldg, W C Gibbs ..... AL 2-2323
Bloomfield N J, 39 Delaware Ave, L E Roher ..... PI 3-9384
Buff 7 N Y, 1807 Elmwood Ave, Robt F Lamb BE-3757
Charlotte 7 N C, 1514 Wendover Rd, Robt S Hudgins ..... ED 3-8446
Cinn 37 O, 1720 Section Rd, W E Hare ..... ME 1-4703
Denver Colo, 4808 S Bwy, Clyde Champion ..... SU 1-0279
Des Moines Ia, 517 Fifth Ave, H G Klug
Det Mich, 2970 W Grand Blvd, M C Schwer ..... TR 1-4900
Evanston Ill, 931 Sherman Ave, C C Hurst ..... SH 3-4450
Indpls 2 Ind, 702 E 10th St, Robt C Simpson ..... ME 1-7420
Indian Orchard Mass, 75 Berkshire St, F M Keefe ..... LI 3-1587
K C 9 Mo, 3519 Troost Ave, Don Parker ..... LO 1-9266
L A 39 Cal, 2439 Riverside Dr, Merrill Berkley ..... NO 3-8291
Milw 4 Wis, 500 W Natl Ave, M A Embertson ..... EV 4-9300
New Rochelle N Y, 27 Locust Ave, Claude A Gates ..... NE 2-1465
Omaha 4 Neb, 2029 N 67th Ave, H G Klub GL-1377
Phila 44 Pa, 27 E Tulpehocken, R C Ayers ..... GE 8-8736
Pgh 21 Pa, 822 Wood St, Earl E Writaker ..... FR 1-6260
Sandy Hook Conn, Box 49, Archie F Roberts ..... NG 6-4550
Salt L City Utah, 323 W 14th So, Wm E Nolet ..... NU 4-6011
San Fran 11 Cal, 200 Davis St, Claude B Smith ..... GA 1-7391
Seattle Wash, 2137 Second Ave, Ray H Branom MA-7320
St Petersburg Fla, 2126 14th St S, H K Wilson
Syracuse 2 N Y, 639 S Warren St, Geo O Miller ..... HA 2-5004
Toledo O, 606 Lagrange St, H Gramlich
Univ City 5 Mo, 6267 Delmar Blvd, Edw W Mooney ..... PA 5-4271
Wayland Mass, Old Sudbury Rd, Robt J Dorey ..... TW 3-7453

Q

Quaker Oats Company, Chemicals Division
Chi 54 Ill, Mdse Mart, Dr Homer R Duffey, Vice-Pres ..... WH 4-0600
Frank F McKinney, Sales Mgr
Cleve 14 O, 815 Superior Ave, R W Reardon ..... SU 1-2828
N Y 5 N Y, 120 Wall St, J J Howe ..... WH 4-0400
Port 14 Ore, 48 SE Hawthorne Blvd, N C Stephens ..... BE 2-6141

Quaker Rubber Division, H K Porter Company
Phila 24 Pa, Tacony & Comly Sts, George A Dauphinais ..... JE 3-4800
Boston 10 Mass, 51 Melcher St, J P Fleming ..... LI 2-5828
Chi 30 Ill, 5555 NW Hwy, F J Tucker ..... SP 4-4500
Cinn 15 O, 430 Mill St Lockland, E L Minnerup ..... VA 1-3591
Dallas 2 Tex, 1327 Levee St, E M Uhls ..... RI 1-1772
Decatur Ga, 508 E Howard Ave, C E Tate ..... DR 8-2562
Houston Tex, 34 Jenkins St, J K Rollins ..... WA 8-2488
Kearney N J, 260 Schuyler Ave, A H Smith ..... KE 2-6670
Mpls 11 Minn, 2201 N Wash Ave, R A Berset ..... JA 2-3679
Phila 24 Pa, Tacony & Comly Sts, A G Webb ..... JE 3-4800
Pgh 22 Pa, 2840 Liberty Ave, N E Thomas ..... AT 1-0151
St Louis 10 Mo, 4006 Papin St, G J Hillebrand ..... JE 5-6645

Quincy Compressor Company
Quincy Ill, 217 Maine St, Mac Irwin, Pres ..... BA 2-7700
Loren Gillhouse, Sales Mgr
Atlanta 3 Ga, 120 Houston St NE, C L LeVeck
Charlotte N C, Box 3351, Wm Yoe
Chi 7 Ill, 1138 W Wash, D C Lambert
Cinn O
Dallas 2 Tex, 1816 Cockrell, Harold Stone
Det 35 Mich, 18051 Jas Couzens Hwy, Robt Carr
Houston 3 Tex, 811 York St, Ray Nesbitt
Media Pa, 311 W Balt Ave, R G Morey
Mpls 6 Minn, 3020 E Franklin St, Bruce Bartelt
N Y 7 N Y, 30 Church St Rm 507, D H Francis
St Louis 20 Mo, 5823 Nat Bridge Blvd, Calvin Keys

R

Raybestos-Manhattan Incorporated
Passaic N J, 61 Willett St, J F D Rohrback, Pres ..... GR 3-2000
H H Burrows, Sr VP-Sales Rubber Div
R B Hazard, VP-Sales Rubber and Packing Div
Birm 1 Ala, 1108 Fifth Ave N, A A Ringland ..... BI 3-5272
Chi 31 Ill, 6010 NW Hwy, G S Himebaugh ..... RO 3-2400
Dallas Tex, 2609 Taylor St, E W Nagel ..... RI 1-5446
Denver 16 Colo, 4500 York St, E T Fair Jr ..... AC 2-8264
Houston Tex, 3012 Canal St, R C Neilson ..... CA 2-9951
L A 58 Cal, 4651 Pacific Blvd, T W Latham ..... LU 8-4254
N O La, 1523 St Ferd St, A E Jackson CR-5509
Phila 3 Pa, 1138 Suburban Sta Bldg, F McBrearity ..... RI 6-8310
Pgh 22 Pa, 810 Empire Bldg, A N Johnston Jr ..... AT 1-3544
San Fran 5 Cal, 131 Mission St, R B Park ..... YU 6-6114

Ray Oil Burner Company
San Fran 12 Cal, 1301 San Jose Ave, R C Westover Jr, Pres ..... DE 3-5800
J C Draper, Sales Mgr
Jersey City 2 N J, 629 Grove St, F X FitzPatrick ..... OL 3-2561

Reading Tube Corporation
N Y 1 N Y, 350 Fifth Ave Rm 2301, Martin Mack, Pres ..... OX 5-1500
Jos F Murray, Genl Sales Mgr
Atlanta Ga, 690 Murphy Ave Unit 5 Bldg B, Frank Skene ..... PL 5-2330
Chi Ill, 718 W 50th St, Art Moisan ..... LI 8-2227
Cleve O, 4615 Perkins Ave, Bernie Roche ..... EX 1-0670
Dallas 19 Tex, 9000 Sovereign Row, Jim Burch ..... FL 7-3837
Denver Colo, 2845 Walnut St, Wells Rutherford ..... AC 2-8673
Houston Tex, 1121 Rothwell St Sec 6, Jake Phillips ..... FA 3-3354
L A Cal, 120 N Santa Fe Ave, Bill Goodwin ..... MA 6-6805
Oakland 21 Cal, 410 Hegenberger Rd, A La Fortune ..... LO 2-4161
Woodside N Y, 57-15 Northern Blvd, Casper Marrione ..... OX 5-1506

Reeves Pulley Company, Division of Reliance Electric and Engineering Company
Columbus Ind, 1225 7th St, Carl M Reeves, Pres 3311
J B Thomas, Sales Mgr Standard Prods Div
Atlanta 9 Ga, 1900 Ardmore Rd, E G Orahood ..... TR 4-1930
Birm 9 Ala, 2830 S 19th St, R T Willard ..... TR 1-1149
Cambridge 40 Mass, 29 Camp St, Donald E Woody ..... LY 4-3006
Chi 41 Ill, 3300 N Knox Ave, C E Hill* ..... MU 5-1500
Cleve 18 O, 13967 Cedar Rd, J H Gepfert* ..... FA 1-7880
Det 21 Mich, 18067 Wyoming Ave, R A Finnigan ..... DI 1-2109
Greenville S C, 209 E Stone Ave, C D Wright 5-7903
L A 22 Cal, 6035 E Olympic Blvd, Jas A Miller* ..... RA 3-8454
Newark N J, 800 Dowd Ave, F R Obenchain ..... EL 4-8300
N Y 17 N Y, 155 E 44th St, I V Falk* ..... OX 7-7373
Phila Pa, 19 E Lancaster Ave, P C Talbot ..... MI 9-1200
Sacramento Cal, 2015 J St, G D Lewis ..... GI 8-1682
San Fran Cal, 1525 Adrian Rd, R G Sullivan* ..... OX 7-5341
*Managers of Transmission Sales

Refinery Construction Company of Houston
Houston 5 Tex, 5008 Kelvin Dr, Dillon B Smith, Pres ..... JA 8-4261
Geo H Zarafonetis, Sales Mgr

Refinery Engineering Company, Division of Vitro Corporation of America
Tulsa Okla, 108 N Trenton, T M Lumly, Pres ..... LU 4-3451

Refinery Supply Company
Tulsa 20 Okla, 621 E 4th St, J B Okeson, Vice Pres ..... GI 7-8141
Houston 3 Tex, 2215 McKinney, Ivan Ray ..... CH 7-5358

Geo P Reintjes Company
K C 41 Mo, 2517 Jeff St, Geo P Reintjes, Owner ..... HA 1-3570
Jerry G Reintjes, Sales Mgr Presur-lite Div
H E Michael, Sales Mgr

Advertisement in this issue, index is on page A-6.

Churchville Pa, 92 Stratford Dr, Wm Overington ..... EL 7-7541
Homewood 49 Ill, 1311 Birch Rd, John F Wooler ..... SY 8-5047
Houston 8 Tex, 2102 Chantilly Lane, Earl L Barron ..... OV 2-2862
Pgh 13 Pa, 3530 Forbes St, Paul Offill Jr ..... MU 1-6601
Youngstown O, 1535 Lansdowne, Dan Strang ..... RI 7-7079

Republic Flow Meters Company
Chi 47 Ill, 2240 Diversey Pkwy, Jas D Cunningham, Pres ..... BR 8-6000
T E Bell, Sales Mgr
Atlanta 1 Ga, Box 1297, T W Waldrop ..... MU 8-7692
Boston 10 Mass, 201 Devonshire St, R E Heath ..... HA 6-4728
Buff 2 N Y, 1006 Prudential Bldg MA-6530
Charleston 3 W Va, 513 Ford St, Geo S Garrett ..... DI 6-5363
Charlotte 2 N C, 127 W 7th St, Bart W Allen ..... FR 5-6597
Chi 47 Ill, 2240 Diversey Ave, Samuel C Vail ..... BR 8-6000
Cinn 8 O, 3197 Linwood Ave, Sten Hammarstrom ..... EA 1-6817
Cleve 15 O, 1900 Euclid Ave, A F Bardsley ..... MA 1-1757
Dallas 35 Tex, 2712 W Mockingbird La, C A Cowles Jr ..... FL 7-1729
Denver 2 Colo, 2415 15th St, E & M Equip Co ..... GE 3-0821
Det 23 Mich, 18230 Grand Riv Ave, J H Warren ..... BR 3-6440
El Paso Tex, 1900 Mills St, H L Peterson ..... EP 3-9060
Houston 25 Tex, 2426 W Holcombe Blvd, G H Woodard ..... MO 4-3447
K C Mo, 4550 Main St, R Benninghoven ..... JE 1-4343
L A 39 Cal, 2439 Riverside Dr, Merrill Berkley ..... NO 2-8291
Mpls 4 Minn, 1525 S 5th St, Hoyt A Sevey Co ..... FE 3-4913
N O 25 La, 4010 Eden St, Wm Scurry ..... UN 1-7061
Long Is City 1 N Y, 26-09 Jackson Ave, L C Walter ..... ST 6-6119
Phila (Ardmore) Pa, 308 Suburban Sq Bldg, E Sweeney ..... MI 2-8630
Phoenix Ariz, 114 E Roosevelt St, Berkley Engrg ..... AL 8-2693
Pgh 22 Pa, Investment Bldg, Ralph E Holmes ..... CO 1-6855
St Louis 17 Mo, 1133 Brentwood Blvd, W G Baker ..... PA 7-3204
Salt L City 4 Utah, 726 S 3rd St W, Pace-Turpin ..... DA 2-5595
San Fran 11 Cal, 420 Mrkt St, Fred H Meyers ..... YU 2-1072
Seattle (Bellevue) Wash, Box 229, Henry Weber (S) MA-5260

Republic Steel Corporation
Cleve 1 O, Republic Bldg, T F Patton, Pres ..... PR 1-1400
Norman W Foy, Sales Mgr
Birm 2 Ala, 1st Ave & 20th St, C B Pharo, Jr ..... AL 1-3281
Boston 16 Mass, 250 Stuart St, Louis Geerts ..... LI 2-3641
Buff 3 N Y, 14 Lafayette Sq, Robert G Shrake MA-5760
Chi 4 Ill, 332 S Mich Ave, Thomas J Gerwig ..... WA 2-3279
Cinn 2 O, 2701 Carew Tower Bldg, Willard Simon ..... PA 1-3801
Cleve 1 O, 902 Republic Bldg, L I Barker ..... PR 1-1400
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Det 2 Mich, 2008 Fisher Bldg, D A Shardelow ..... TR 5-9300
Houston 2 Tex, Niels Esperson Bldg 20th Fl, E E Haubegger ..... CA 2-0182
Indpls 4 Ind, 800 Circle Tower, J N Segerson ..... ME 2-5386
L A 17 Cal, 612 S Flower St, Henry A Bourne MI-5144
N Y 17 N Y, 405 Lex Ave, H E McPherson ..... OX 7-9500
Phila 3 Pa, 1617 Penna Blvd, T M Gloeckner ..... RI 6-8900
Pgh 22 Pa, 537 Mellon Sq, N E Walker ..... GR 1-2425
St Louis 3 Mo, 1221 Locust St, W F Schupp ..... CH 1-8165
Seattle 1 Wash, 6636 White-Henry-Stuart Bldg, L A Wigley MA-8583
Tulsa 3 Okla, 2003 Philower Bldg, C W Kennedy ..... DI 3-6263
Wash 6 D C, 1625 K St NW, J C Black ..... NA 8-5990
Warren O, 1040 Pine Ave SW, C G Medley WA-2251

Research-Cottrell Incorporated
Bound Brook N J, C W Hedberg, Pres ..... EL 6-2600
C E Beaver, VP-Sales
Chi 1 Ill, 228 N LaSalle St, H D O'Rourke ..... FR 2-4546
N Y 17 N Y, 405 Lex Ave, W W Moore ..... YU 6-6622
Pgh 19 Pa, Grant Bldg, H L Richardson ..... AT 1-3773
San Fran 4 Cal, 58 Sutter St, W W Blessing ..... YU 2-3852

Ridge Tool Company The
Elyria O, 400 Clark St, C H Ingwer Sr, Pres ..... FA 2-4651
W L Parcell, Sales Mgr

Rivett Incorporated, Division of Rivett Lathe and Grinder Inc
Boston Mass, 35 Brighton St, A B Hunt, Pres ..... ST 2-4530
J A Marsh, VP-Sales Valves & Cylinders Div
Bell Cal, 64 E Gage Ave, J E Munroe ..... LU 7-5226
Cinn O, 78 Hamlin Dr, H A Jones ..... WE 1-8133
Cleve O, 21000 St Clair Ave, Wm Reiff .....
Dayton O, 11 W Monument Ave, H A Jones HE-8346
Denver Colo, 5975 Colo Blvd, E L Heim .....
Det Mich, 3020 E Canfield, E N DeLalla .....
Houston Tex, 4716 Eli, Mr. Church ..... UN 2-8874
Maplewood N J, 1990 Springfield Ave, Mr. Lipton ..... SO 2-1700
McKees Rocks (Pgh) Nichol Ave, A R Schroeder ..... SP 1-4810
Miami Fla, 543 NW 5th St .....
Oakland Cal, 6002 Telegraph Ave, E Ditzen ..... OL 3-8262
St Paul Minn, 2631 Univ Ave .....
Salt L City Utah, 334 W 17th South St, J M Grisley .....
Schiller Pk Ill, Box 66, H MacMillin ..... GL 5-6200
Tulsa Okla, Box 1652, J G Burke .....

I S Roberts
Ridley Pk Pa, 412 Harrison St, I S Roberts, Pres ..... LE 2-3817

Robinson Orifice Fitting Company of Texas
Houston 31 Tex, 12233 Robin Blvd, Wm C Robinson, Pres ..... JA 8-0575
T V Strain, Sales Mgr Houston Div
Alex Espinoza, Sales Mgr Los Angeles Div
Houston 31 Tex, 12233 Robin Blvd, J D Muff ..... JA 8-0575
L A 23 Cal, 2830 Lugo St, O W Muff ..... AN 9-1161

Rockwell Manufacturing Company, Division of Meter and Valve
Pgh 8 Pa, 400 N Lex, W F Rockwell Jr, Pres ..... CH 1-8400
H Gottwald, Sales Mgr Rockwell-Nordstrom Valve Div
Atlanta 1 Ga, 1495 Northside Dr NW, Herbert Parker ..... TR 6-2691
Boston (Needham 92) Mass, 1233 Highland Ave, F C Arens ..... HI 4-0035
Charlotte 2 N C, 222 S Church St, Geo A Cunningham ..... ED 4-6466
Chi 3 Ill, 122 S Mich Ave, R V Burnette ..... HA 7-7821
Dallas 1 Tex, 310 Mercantile Comm Bldg, E D Propps ..... RI 7-2559
Denver 2 Colo, 208 Mile High Ctr Bldg, O Cackran ..... MA 3-0278
Det 26 Mich, 1862 Natl Bk Bldg, M F Groom ..... WO 5-7667
Houston 3 Tex, 1102 Delano St, Jas Dvoracek ..... CA 8-6601
L A 23 Cal, 3136 E 11th St, R B Kitzmiller ..... AN 1-6107
Midland Tex, 128 Central Bldg, E Y Pettit ..... MU 2-8786
N Kans City 16 Mo, 1249 Burlington Ave, M D Gilbert ..... GR 1-4747
N O 12 La, 643 Natl Bk of Comm Bldg, M A Bradburn CA-3531
N Y 1 N Y, 7701 Empire State Bldg, C J Kentler Jr ..... LO 5-4830
Phila Pa, 1 Bala Ave (Bala-Cynwyd), J H Perry ..... MO 4-0940
Pgh 8 Pa, 400 N Lex Ave, C B Goff Jr ..... CH 1-8400
San Fran 5 Cal, 525 Mrkt St, W F Gulley ..... GA 1-0071
Seattle 99 Wash, 119 W Danny Way, R E Nimtz MU-8320
Shreve La, 328 Ricou-Brewster Bldg, D D Collins 3-1535
Tulsa 1 Okla, 3130 Sand Sprgs Rd, O W Barnett ..... GI 7-5144

Rome Cable Corporation
Rome N Y, Ridge St, A D Ross Fraser, Pres RO-3000
D H Thayer, Sales Mgr
J R Woods, Sales Mgr
Atlanta 13 Ga, 156 Simpson St NW, C G McMurry ..... MU 8-9860
Boston 10 Mass, 80 Federal St, A D Stein ..... HA 6-7272
Chi 39 Ill, 4505 W Grand Ave, Stewart Johnston ..... SP 2-2700
Cleve 14 O, 145 Public Sq, C R Evans ..... SU 1-1240
Dallas 26 Tex, 3015 Taylor St, F J Peabody ..... RI 7-4801
Denver 4 Colo, 1160 Elati St, E T Vanier ..... KE 4-0533
Det 2 Mich, 521 New Center Bldg, A K Buckenmaier ..... TR 2-7578
Houston 2 Tex, 240 Shea Pl, G A Peabody ..... FA 3-8385
K C 11 Mo, 406 W 34th St, R R Davis ..... JE 1-4146
L A 22 Cal, 2510 S Malt Ave, H S Warren ..... RA 3-3631
N Y 17 N Y, 60 E 42nd St, E T Buckenmaier ..... MU 2-6590
Phila 7 Pa, 12 S 12th St, W A Miller ..... MA 7-2070
Pgh 22 Pa, 1001 Oliver Bldg, R A Gray ..... AT 1-0816
St Louis 17 Mo, 6617 Clayton Rd, D A Thomas ..... VO 3-4944
St Paul 4 Minn, 345 N Wheeler Ave, T H Stokke ..... MI 6-7201
Salt L City 1 Utah, 230 S 4th West, H L Rawlings ..... EL 9-8811
San Fran 24 Cal, 1100 Selby St, C H Kaufman ..... VA 6-3580
Seattle 4 Wash, 3430 4th Ave S, A M Mitrovich SE-3017
Torrance Cal, 1739 213th St, R E Gates ..... NE 6-5704

Roots-Connersville Blower Division, Dresser Industries, Inc.
Connersville Ind, 900 W Mount, R R Newquist, Pres 1500
D A Johann, VP-Sales
G H Crocker, Facory Sales Mgr
H W Berghegger, Sales Mgr Meter Div
Birm 6 Ala, 5018 1st Ave N, D B Gooch Assoc ..... LY 2-8191
Boston Mass Blower Div .....
Buff 21 N Y, 6045 Main St, Bass Ind Equip Co PL-0600
Butte Mont, Box 208, G M Wallace and Co 2-8391
Chattanooga 11 Tenn, Box 8205, P A Chapman Assoc ..... AM 6-5863
Chi 26 Ill, 1737 W Howard St, Blower Div ..... BR 4-5113
Cleve 15 O, 1900 Euclid Ave Rm 601, Blower Div ..... PR 1-8386
Dallas 19 Tex, 2512 W Mockingbird La, Marshall, Neil ..... FL 1-5347
Denver 2 Colo, Denham Bldg, G M Wallace & Co ..... AM 6-0386
Det 2 Mich, 4917 Schaefer Rd, Blower Div ..... LU 2-3403
Houston 19 Tex, 3513 W Dallas, Marshall, Neil ..... JA 9-3596
Johnson City Tenn, 801 W Walnut St, P A Chapman 3113
K C 12 Mo, 4706 Holly St, K C Equip Co ..... PL 3-3737
L A 22 Cal, 5442 Jillson St, Preferred Equip Co ..... RA 3-6391
N O 18 La, 420 Huso St, Marshall, Neil and Pauley ..... UN 1-8114
N Y 17 N Y, 122 E 42nd St, Blower Div ..... OX 7-2800
Phila (Haverford) Pa, 357 Lancaster Ave, Blower Div ..... MI 2-4638
Phoenix Ariz, Box 6104, Ken Smith Company ..... AL 8-0901
Pgh 19 Pa, 2411 Grant Bldg, Blower Div ..... AT 1-5571
Port 22 Ore, 12200 SE Oatfield Rd, C L Koerner ..... OL 4-8773
St Louis 17 Mo, 2010 Big Bend Blvd, Sample Bros ..... ST 1-7941
Salt L City Utah, Dooly Bldg, G M Wallace & Co ..... EM 4-5611
San Fran 5 Cal, 593 Mrkt St, Rm 610, Blower Div ..... EX 2-0232

Ross Heat Exchanger Division of American-Standard, Division of American Radiator & Standard Sanitary Corporation
Buff 25 N Y, 2777 Walden Ave, R S Reade, Pres MU-1050
Paul W Wilcox, Sales Mgr Ross Heat Exch Div
Alexandria Va, 515 Wythe St, Roland D Baker ..... KI 8-3685
Ardmore Pa, Suburban Sq Bldg, Sydney King ..... MI 2-8170
Berkeley 7 Cal, 1715-B Solano Ave, H P Johnson ..... LA 4-6429
Buff 7 N Y, 1807 Elmwood Ave, Roland Stowers RI-9563
Cinn 26 O, 823 Delta Ave, Myron B Hamilton ..... EA 1-6761
Decatur Ga, 522 N McDonough St Rm 209, Fred M Mahan ..... DR 8-4134
Det 35 Mich, 19735 Jas Couzens Hwy, Fred J Lupke ..... BR 3-2810
Evanston (Chi) Ill, 1324 Chicago Ave, Geo W Morris ..... BR 4-8230
Houston 5 Tex, 2370 Rice Blvd, F N Currier ..... JA 6-1854
Milw 3 Wis, 2040 W Wisc Ave, Verne Jamison ..... DI 2-2276
N Y 18 N Y, 40 W 40th St, R G Schreiner ..... LO 5-6820
Wakefield Mass, 404 Main St, Paul Kelleter ..... CR 9-0077

Milton Roy Company
Phila 18 Pa, 1300 E Mermaid Lane, Robt T Sheen, Pres ..... CH 7-8000
John Procopi, Sales Mgr
Albuquerque N M, Denver Fire Clay Co ..... AL 3-1710
Appleton Wis, Crane Engineering Sales Co ..... AP 3-4425
Atlanta Ga, Boiler Equip Serv Co ..... EL -3636
Birm Ala, D B Gooch Associates ..... LY 2-8191
Boston Mass, Cochrane Steam Spec Co ..... HA 6-6447
Buff N Y, R L Schwartz ..... WA -1168
Charleston W Va, Industrial Equip Co ..... CH 3-7606
Charlotte N C, Brown and Morrison ..... ED 3-7475
Chi Ill, Fuente and Webster ..... DE 2-3764
Cinn O, E C Werner ..... AV 1-5840
Cleve O, Chemical Pump & Equip Corp of Cleve ..... LO 1-3025
Dallas Tex, J R Dowdell and Co ..... TA 3-9901
Davenport Ia, Deco Engrg Co ..... DA 7-6123
Denver Colo, Floyd H Bayer ..... AL 5-6770
Des Moines Ia, Deco Engrg Co ..... DM 8-5721
Det Mich, Du-Bois Webb Company ..... BR 3-0880
El Paso Tex, Denver Fire Clay Co ..... EP 3-3497
Houston Tex, M N Dannenbaum Co ..... WA 3-7655
Indpls Ind, Jackson Engrg Co ..... ME 4-3463
K C Mo, Sullivan-Mears Co ..... WE 1-3021
L A Cal, Simonds Pump Co ..... MU -8322
Lubbock Tex, J R Dowdell and Co ..... SH 4-2388
Memphis Tenn, Johnson and Scott ..... JA 5-8693
Mpls Minn, Hoyt A Sevey ..... AT -4913
Newark N J, W K Sims ..... MI 2-1969
N O La, R V Gildersleeve Co ..... RA -8206
N Y N Y, Chemical Pump & Equip Corp ..... BO 9-7544
Phila Pa, Maleson Co ..... EV 2-6400
Pgh Pa, Ramsey Pump and Supply Co ..... CO 1-1155
Port Ore, Tower Equip Co ..... OL 4-1745
Richmond Va, O'Neill Pump & Engrg Co ..... RI 7-4828
St Louis Mo, Wharton L Peters Machy Co ..... JE 5-3700

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Salt L City Utah, Denver Fire Clay Co ..... SL 4-5565
San Fran Cal, Simonds Machy Co ..... DO 2-6794
Schenectady N Y, Chemical Pump & Equip Corp ..... SC 6-3376
Seattle Wash, Tower Equip Co AD-1460
Springfield Mass, C V Petrou ..... SP 3-0275
Syracuse N Y, Chemical Pump & Equip Corp ..... SY 3-4797
Tulsa Okla, Vanco Engrg Co ..... RI 7-0425
Wichita Kans, Sullivan-Mears Co ..... FO 3-6414

R-P&C Valve Division, American Chain and Cable Company Inc
Reading Pa, H L Cummings 6-2881
C L Haslup, Sales Mgr

Russell Engineering Corporation
Houston 5 Tex, 2609 Sunset Blvd, Geo F Russell, Pres ..... MA 3-4423

✔ Rust-Oleum Corporation
Evanston Ill, 2425 Oakton St, Robt A Fergusson, Pres ..... BR 4-4090
Jack N Copeland, Sales Mgr Engrg Dept
Dallas Tex, 3200 McKinney Ave, Myrtle McConnell ..... LA 8-7453

S

Sarco Company Incorporated
N Y 1 N Y, 350 Fifth Ave, H L Simmons, Pres ..... CI 4-5767
A Milnes, Sales Mgr Industrial Div
L Barfus, Sales Mgr Heating Div

Sauerman Bros Incorporated
Bellwood Ill, 620 S 28th Ave, J A Sauerman, Pres ..... LI 4-4892
J R Dillon, Sales Mgr

Schield Bantam Company
Waverly Ia, Vern L Schield, Pres 840
Buel M Wallis, Sales Mgr

Schramm Incorporated
West Chester Pa, Virginia & Garfield Aves ..... OW 6-2500
Henry N Schramm, Pres
Leslie B Schramm, Sales Mgr
P F Smith, Dealer-Sales Mgr
Chi 59 Ill, 5550 W North Ave, Ray E Hearl ..... TU 9-4412
L A 21 Cal, 846 E 6th St, Conrad Creim TU-2431
N Y 6 N Y, 90 West St Rm 807, Jas F McTeague ..... CO 7-0640
Phila 40 Pa, 1412 Belfield Ave, Geo A Naab ..... GL 5-7500
San Fran 3 Cal, 1315 Howard St, Bert B Jarl ..... UN 3-6655
Wash 7 D C, 1254 23rd St NW, John A Harley ..... FE 3-7280

Schutte and Koerting Company
Cornwells Hgts Bucks County Pa, V W Fischer, Pres ..... ME 9-0900
F L Seibold, VP-Mrktg-Sales
Houston 25 Tex, 4007 Bellaire Blvd ..... MA 3-1252
Oak Pk (Chi) Ill, Box 1098 ..... AU 7-6239
N Y 7 N Y, 50 Church St ..... CO 7-3570

Scientific Design Company Incorporated
N Y 16 N Y, 2 Park Ave, Harry A Rehnberg ..... MU 9-3176
Thomas P Brown, Vice Pres

Scientific Glass Apparatus Company Incorporated
Bloomfield N J, 100 Lakewood Terrace, Wm O Geyer, Pres 3-2200
John Miller, Sales Mgr
Silver Spg Md, 9419 Georgia Ave ..... JU 7-7050

Scovill Manufacturing Company
Waterbury 20 Conn, 99 Mill St, S M Main, Div Mgr ..... PL 4-1171
R M Broker, Sales Mgr Hose Couplings Dept
Cleve O, 4635 W 160th St, H J Asma ..... OR 1-1500
L A 22 Cal, 6464 E Flotilla St, H Javitt ..... RA 3-7221
N Y 17 N Y, 161 E 42nd St, G D Engle ..... OX 7-3222
San Fran 7 Cal, 434 Brannan St, K Reid ..... GA 1-1923

Sealol Corporation
Prov 5 R I, Warwick Ind Pk, C W Williamson, Pres ..... ST 1-4700
Harold F Greiner, Sales Mgr Marine & Ind Divs
Galveston Tex, 021 16th St, Gulf Coast Supp Co 2-3191
Jacksonville Fla, Gary & Larue Sts, United Marine & Engrg Co ..... EX 8-9460
Lansdown Pa, 21 Mansfield Rd, Sealol Corp ..... CH 2-2226
Mobile Ala, 307 N Royal St, Bell & Co ..... HE 2-4658
N Y NY, 11 Bwy Rm 819, Evan L Price Co ..... WH 3-9748
Norfolk Va, 407 Union St, Paxton Co ..... MA 2-1606
Port Ore, 2211 NW Front Ave, Chas Lowe Co, Bessco Div ..... CA 8-6409
Prov 5 R I, Sealol Corp, Harold Greiner ..... ST 1-4700
Seattle Wash, 2208 White-Henry Stuart Bldg, C Lowe MU-6860
Wilm (L A) Cal, 226 N Marine Ave, Marine Pumps Inc ..... TE 4-8516

Selas Corporation of America
Dresher Pa, Dreshertown Rd, F O Hess, Pres ..... MI 6-6600
K W Fleischer, Sales Mgr Fluid Processing Div
J F Black, Mgr Steel Mill Div
Q M Bloom, Mgr Furnace & Kiln Div
C A McFadden, Mgr Genl Ind Div
G V Jordan Jr, Mgr Micro Proc Div
Chi 24 Ill, 3857 W Wash Blvd, R S Van Note ..... NE 2-1161
Cleve 24 O, 1108 Gordon Rd, T G Thurston ..... HI 2-6225
Dayton 6 O, 2118 Salem Ave, M O Kaufman ..... CR 4-5492
Denver 5 Colo, 2636 Walnut St, S G Glick ..... MA 3-7200
Dresher Pa, (Phila) R C Jordan ..... MI 6-6600
Det 2 Mich, 334 Lex Bldg, E D Allen ..... TR 5-1221
Houston 7 Tex, 8312 Hempstead Rd, T P Drummond ..... UN 4-7733
L A 25 Cal, 11168 Santa Monica Blvd, S A Whitehurst ..... GR 3-2316
Newark 2 N J, 9 Clinton St, W C Schneider ..... MA 3-5226
N Y 17 N Y, Rm 703 Chrysler Bldg, G E Mitchell ..... YU 6-9654
Pgh 34 Pa, 3829 Willow Ave, J L Wilson ..... LO 1-0115
Roch 18 N Y, 94 Fairmeadow Dr, K E Rasmussen ..... GR 3-6370
St Louis 24 Mo, 8643 Brookshire Ln, R M Breckenridge ..... WY 1-1070
Seattle 8 Wash, Boeing Field Box 37, H V Wenger Jr LA-5940
W Hartford Conn, 62 LaSalle Rd Rm 207, F K Whitside ..... AD 2-9777

Servonic Instruments Incorporated
Costa Mesa Cal, 640 Term Way, Jas A DeJulio, Pres ..... MI 6-2427
Patrick S Chase, Sales Mgr
L A 45 Cal, 5140 Crenshaw Blvd, Lee Garwood, Tech Rep

Shafer Valve Company
Mansfield O, 2500 Park Ave W, H J Shafer, Pres ..... LA 2-8311
Denver 19 Colo, 2882 S Zenobia St, E H Parker ..... WE 5-8062
Houston 5 Tex, 308 Times Ctr Bldg, C C Pryor ..... JA 2-7515
Houston Tex, 2330 Sul Ross St, J W Leggett ..... JA 8-5495
Hyde Pk (Boston) Mass, 167 Garfield Ave, J D McCarthy ..... HP 3-4473
Orinda (Oakld) Cal, 43 Moraga Hwy, H A Altorfer ..... CL 4-4616
Shreve La, 304 Sklar Bldg, Lynn McGuffy 3-3466
Tulsa Okla, 3324-D E 31st St, Don E Dixon ..... RI 7-6340

Shand and Jurs Company, Division General Precision Equip Corp
Berkeley 10 Cal, Carleton & 8th Sts, R M Young, Pres ..... AS 3-2345
E E Jurs, VP-Sales
Chi 43 Ill, 10409 S Western Ave, Robt Blake ..... CE 3-5500
Houston 2 Tex, M & M Bldg, J M Greenlee ..... CA 4-2541
L A 48 Cal, 6399 Wilshire Blvd (715) Ralph M Smith ..... WE 5-2877
N Y 17 N Y, 110 E 42nd St, Ralph Ley ..... MU 2-0997
Tulsa 3 Okla, 310 Thompson Bldg, Breen Ringland ..... DI 3-8082

Shaw-Box Crane and Hoist, Division Manning, Maxwell & Moore Inc
Muskegon Mich, W Broadway, A R Walkley, Div Mgr 31-311
G A Andree, Sales Mgr
J E Minty, Dir of Eng

Sherman Products Incorporated
Royal Oak Mich, 3200 W 14 Mile Rd, W A Romain, Pres ..... LI 9-3400
W E Henderson, W W Wigle, Sales Mgrs
Represented by Ford Tractor Distributors

Sherwin-Williams Company, Pigment, Color & Chemical Division
N Y 16 N Y, 260 Mad Ave, B M Van Cleve, VP-Div Mgr ..... LE 2-5806
Boston 16 Mass, 30 Huntington Ave, O C Kees ..... CO 7-5450
Chi 6 Ill, 300 W Lake St, F P Squibb ..... FI 6-0500
Cinn 2 O, 616 Main St, P O Darr ..... MA 1-4209
Cleve 1 O, 101 Prospect Ave, C A Case ..... TO 1-7000
Det 26 Mich, 2036 Woodward Ave, V L Sahli ..... WO 1-7015
Houston 19 Tex, 1 Briar Dale Ct, O H Clark ..... MA 3-9502
L A 33 Cal, 363 S Mission Rd, D K DeBoay ..... AN 9-8237
N Y 16 N Y, 260 Mad Ave, R A Bowen ..... LE 2-5896
Oakland 8 Cal, 1450 Sherwin Ave, J N Morris ..... OL 2-2700
Phila 7 Pa, 325 N Broad St, G E Falkenberg ..... MA 7-3300
St Louis 5 Mo, 559 Skinker Blvd, H B Caywood ..... VO 3-6999

T Shriver and Company Incorporated
Harrison N J, 872 Hamilton St, W L Hutton, Pres ..... HU 4-2500
J L Hutton, VP-Sales
R K Jessen, Sales Mgr
Decatur Ga, Rutland Bldg, R D Robertson CR-1681
Houston 5 Tex, 2323 Univ Blvd, R L Watts ..... JA 8-3324
Livonia Mich, 12201 Merriman Rd, W R Wert ..... KE 1-1785
St Louis 19 Mo, 331 Thornton Ave, S L Lopata ..... WO 2 7771
San Fran 24 Cal, 1485 Bayshore Blvd, W H Edis ..... JU 4-7748

Silicones Division, Union Carbide Corporation
N Y 17 NY, 30 E 42nd St ..... MU 7-8000
Representatives in Principal Cities

M. B. Skinner Company
South Bend Ind, 3502 W Sample, K G Merrill, Pres ..... AT 8-2501
F R McMurray, VP Sales

S K F Industries Incorporated
Phila 32 Pa, Front St & Erie Ave, E R Broden, Pres ..... GA 6-6400
J H Sutherland, Dir of Sales
Atlanta 9 Ga, 1052 W Peachtree St NW, F J Matte ..... TR 5-8846
Birm Ala, 412 S 41st St, G E Allen and W C Sessions ..... LY 2-0988
Boston 34 (Allston) Mass, 210 N Harvard St, D H Amidon ..... AL 4-8400
Buff 2 N Y, 621 Genesee Bldg, H G Wallace WA-0966
Charlotte 3 N C, 2935 S Griffith St, J T Paradise ..... JA 3-6932
Chi Ill, See Melrose Pk Office Listing, M W Passmore ..... MA 6-7456
Cinn 13 O, 6115 Wiehe Rd, L E Jacobs ..... RE 1-7117
Cleve 15 O, Rm 701 Hanna Bldg Annex, P R Payson ..... MA 1-7876
Dallas 26 Tex, 2720 Taylor St, R M Parrish ..... RI 2-4116
Denver 2 Colo, 1420 18th St, A H Dixon ..... MA 3-3924
Det 35 Mich, 18350 Schaefer, W C Ahlers ..... UN 4-9373
Hartford 3 Conn, 410 Asylum St, D H Amidon ..... JA 7-4744
Houston 4 Tex, 4101 San Jacinto St, E T Teal ..... JA 9-2164
L A 7 Cal, 3131 S Hill St, R M Parrish ..... RI 9-3168
Melrose Pk (Chi) Ill, 1800 N 25th Ave, M W Passmore ..... FI 5-5150
Milwaukee 16 Wis, 4730 W Fond du Lac Ave, K E Trautwein ..... HI 2-5990
Mpls 4 Minn, 1228 7th St S, I J Torkelson ..... FE 3-8971
Phila 32 Pa, 3333 W Hunting Pk Ave, H W Speidel ..... SA 2-0111
Pgh 37 Pa, 1130 Perry Hwy, R E Campbell ..... WE 1-2955
Port 9 Ore, 1625 NW Hoyt St, E Isopero ..... CA 8-4309
St Louis 10 Mo, 2149 Hampton Ave, R S Smith ..... MI 7-3444
San Fran 7 Cal, 790 Tenn St, F W McCann ..... MI 8-4425
Seattle 9 Wash, 170 Denny Way, D C Spooner ..... SE 4454
Teterboro N J, 20 Henry St, H Wood ..... AT 8-1700
Tulsa 3 Okla, 420 S Main St, C F Wagnon ..... DI 3-1097
Youngstown O, 102 Shutrump Ct Sickliffe Sect, P W Petzold ..... SW 9-1561

A O Smith Corporation, Meter Products Division
L A 22 Cal, 5715 Smithway, W L France, Genl Mgr ..... RA 3-3361

Nowery J Smith Company
Houston 8 Tex, 8000 Hempstead Hwy ..... UN 9-1425
Cooper F Hawthorne, Genl Mgr
Joe B Pigford, Sales Mgr Hot-Dip Galv Div
Carl A Roehl, Sales Mgr Special Coatings

Snap-On Tools Corporation
Kenosha Wis, 28th Ave, Joseph Johnson, Pres ..... OL 4-8681
Rogers Palmer, VP-Sales
G S Childress, Genl Sales Mgr
M B Steinmetz, Sales Mgr Ind Div
D C Beaulieu, Sales Mgr International Div
Albany 12 N Y, 118 Everett Rd, I V Johnson 8-4056
Atlanta 13 Ga, 380 Techwood Dr NW, J M George Jr ..... JA 4-8451
Balt 5 Md, 4503 E Monument St, D J Johnson ..... DI 2-4466
Birm 4 Ala, 810A Fifth Ave N, A M Veney ..... FA 2-8781
Boston 35 Mass, 116 N Beacon St, H B Miller ..... ST 2-2230
Brklyn 3 N Y, 1033 Utica Ave, W J Springer ..... HY 5-9595
Buff 13 N Y, 628 W Utica St, G H McCreery GA-6374
Butte Mont, 115 E Granite St, O L Ford 2-8762
Charlotte 8 N C, 1015 W Morehead St, L W Baxter ..... FR 5-7704
Chi 7 Ill, 120 N May St, C R Caldwell ..... TA 9-2651
Cinn 17 O, 4205 Vine St, W D Huffman ..... WO 1-3188
Cleve Hts 18 O, 2066 S Taylor Rd, J S Watson ..... ER 1-3457
Dallas 26 Tex, 2932 Commerce St, L C Hollenbeck ..... RI 1-1611
Denver 3 Colo, 1050 Bwy, D D Southard ..... AL 5-5406
Des Moines 9 Ia, 609 E Walnut St, W P Goodwin ..... CH 3-3357
Det 2 Mich, 93 Piquette Ave, W J Sharbach ..... TR 5-6455

✔ Advertisement in this issue. index is on page A-6.

COMPANY DIRECTORY

Fargo N D, 421 N P Ave, W Thierey 5-1381
Harrisburg Pa, 4200 Chambers Hill Rd, J J Hope ..... CE 2-6854
Houston 2 Tex, 1810 LeBranch St, H V Lollar ..... CA 5-5404
Indpls 2 Ind, 848 Ft Wayne Ave, W P Aschinger ..... ME 4-8339
Jacksonville 6 Fla, 1601 Walnut St, L N Scott ..... EL 4-4469
K C 11 Mo, 3635 Main St, H W Jamison ..... WE 1-0364
L A 17 Cal, 1717 W 6th St, M A Zurbriggen ..... DU 8-3445
Louisville 4 Ky, 1609 Eastern Pkwy, L J McCarthy HI-6317
Lubbock Tex, 1914 4th St, T W Gibbs ..... PO 2-0113
Metairie (N O) La, 2319 Metairie Rd, E L Barber ..... VE 5-3188
Miami 48 Fla, Box 626, Robt Reinhold ..... TU 7-7336
Milw 3 Wis, 2600 W State St, G W Harrington ..... WE 3-3116
Mpls 26 Minn, 6418 W Lake St, H J MacMillan ..... WE 9-7841
Newark 6 N J, 823 Sandford Ave, J E Parker ..... ES 5-3197
N Y 67 N Y, 2807 White Plains Rd, Ned Jaffrey ..... TU 2-6868
Oakland 7 Cal, 2605 Mrkt St, E F MacIlvain ..... HI 4-5986
Okla City 3 Okla, 901 N Hudson St, H C Dingee ..... PO 5-3301
Omaha 10 Neb, 3601 N 24th St, T C Hall PL-3116
Peoria Ill, 1746 N Sheridan Rd, W E Norman 5-2461
Phila 30 Pa, 1710 Fairmount Ave, I A Mason ..... PO 5-7400
Phoenix Ariz, 3229 E Wash St, L C Anderson ..... BR 5-2489
Pgh 21 Pa, 630 Ardmore Blvd, G H McCreery ..... CH 2-5551
Rich 20 Va, 1617 W Broad St, A B Phillips 5-8115
Salt L City 15 Utah, 1721 S Main St, C S Bolt ..... HU 4-5854
Seattle 7 Wash, 4503 8th Ave NW, L E Nelson SU-2192
St Louis 10 Mo, 2165 Hampton Ave, F H Wendell ..... JE 1-2111
Syracuse 6 N Y, 1622 Burnet Ave, C S Jaffrey 9-7561
Toledo 6 O, 2932 Monroe St, D J Krummack ..... CH 3-1026

Foster D Snell Incorporated
N Y 11 N Y, 29 W 15th St, Foster Dee Snell, Pres ..... WA 4-8800
Walter L Hardy, Sales Mgr
Bainbridge N Y, Supply Div, Mrs. Esther C Swart 3431
Balt 2 Md, Crippen & Erlich Div, R C Crippen ..... BE 5-6350
Worcester Mass, Davis & Bennett Div, Benj Seibel ..... PL 5-0254

Solvent Service Incorporated
Painesville O, 772 Oak St, W R Elliott, Pres ..... EL 4-9991
Buff 14 N Y, 3053 Main St, Robt Schell WI-8358
Pgh 28 Pa, 295 Beverly Rd, Jack Tarbet ..... FI 1-7622
Schererville Ind, Box 398, Reece Kincaid, Dyer (Ind) ..... UN 5-8600

Sonic Engineering Corporation
Stamford Conn, 146 Selleck St, E C Cottrell, Pres ..... DA 5-1305
San Fran Cal, John P Baird-Jones

Southwestern Engineering Company
L A 58 Cal, 4800 Santa Fe Ave, Robt P Miller, Pres ..... LU 3-6262
G B Faust, VP-Sales Mfg Div
O C Rodday, Sales Mgr Engrg & Construction Div
A A Ficery, Sales Mgr Separator Div

Southwestern Plastic Pipe Company
Mineral Wells Tex, Box 117, E W Hendrick, Genl Mgr ..... FA 5-3344
Chas B Turner, Dir of Sales
Harry Riley Jr, Sales Mgr Wholesale Divs
A J Brumbough, Sales Mgr Ind Oil & Field Divs

Sparkler Manufacturing Company
Mundelein Ill, 169 N Lake St, A C Kracklauer, Pres ..... MU 6-6430
Frank H Passalaqua, VP-Sales
D F Cooper, Sales Mgr Ind Div
D D Baldwin, Sales Mgr Water Div
F W Kracklauer, Sales Mgr Sugar Filter Div
R Blavitzky, Sales Mgr Ind Div

Speedline Fittings Division, Horace T Potts Company
Phila 34 Pa, Erie Ave & D St, Horace T Potts II, Pres ..... GA 6-4600
John W Reckard, Genl Sales Mgr
Wm H Van Horn, Mgr Speedline Sales Div
Balt 11 Md, 2835 Sisson St, D C Taylor ..... HO 7-6800
York Pa, 53 N Duke St, C R Eppinger ..... YO 81-250

Spee-Flo Company
Houston Tex, 720 Polk St, G Levy, Pres ..... CA 5-0461
Stan Harvey, Sales Mgr

Spencer Chemical Company
K C 5 Mo, Dwight Bldg, Kenneth A Spencer, Pres ..... BA 1-6600
H R Dinges, VP-Sales Industrial Chem Div
Chi Ill, 912 First Natl Bk Bldg ..... RA 6-3790
N Y NY, 500 Fifth Ave ..... LA 4-7762

Spencer Turbine Company
Hartford 6 Conn, 486 New Park Ave, L C Smith, Pres ..... AD 3-6293
R A Brackett, Sales Mgr
Chi 4 Ill, 53 W Jackson Blvd, C E Ludwig
Newark 2 N J, 24 Commerce St, R Graff
N Y 17 N Y, 101 Park Ave, R Webber
Wash 4 D C, 9th & F Sts NW, F Winsten

Square D Company, EC&M Division
Cleve 28 O, 4500 Lee Rd, A G Patterson, Pres ..... EN 1-1076
W R Yorkley, Sales Mgr
Ed Love, Sales Mgr Ind Control Div
M P Kartalia, Sales Mgr Distribution Equip

Stapp Engineering Corporation The
Denver 15 Colo, 700 Carr St, Milo A Stapp, Pres ..... BE 3-4218
Bert M Maich, Sales Mgr

Stauffer Chemical Company
N Y 17 N Y, 380 Madison Ave, Hans Stauffer, Pres ..... OX 7-0600
S S Emison, VP-Sales

Staytite Company The
Houston 3 Tex, 3608 Polk Ave, H J Glauser Jr, Pres ..... FA 3-4354
N M Christensen, Sales Mgr

Ned C Stearns Company
Shreve La, 1841 Claiborne Ave 7-0584

Stearns-Roger Manufacturing Company The
Denver 17 Colo, 660 Bannock St, Chas Voight, Pres ..... AC 2-8484
M G Brenna, VP-Power Plant
Harvey Mathews, VP Mining-Chem-Metallurgical Divs
Louis Weiss, VP Gas-Oil Divs
El Paso Tex, 708 Electric Bldg, J G Clarkson ..... KE 3-5501
Houston Tex, 1115 City Natl Bk Bldg, Geo E Ohler ..... CA 4-6501
Salt L City Utah, 40 Richards St, D M Mills ..... DA 2-5891

Sterling Electric Motors Incorporated
L A 22 Cal, 5401 Telegraph Rd, E E Olson ..... RA 3-6211
John R Howell, VP-Sales
C M Aswell, VP-Mrktg
Atlanta 3 Ga, 1911 Rhodes-Haverty Bldg, Geo Stinsman ..... JA 4-3681
Boston (Wellesley Hills) 47 River St, R L Bedell ..... CE 7-9700
Chi 47 Ill, 3225 W North Ave, Earl J Phillips ..... SP 2-8866
Cinn (Norwood) 12 O, 4610 Smith Rd, Jos H Fallon ..... RE 1-5432
Cleve 15 O, 1836 Euclid Ave Rm 519, B A Pritts ..... PR 1-6268
Denver 16 Colo, Box 6735 Stkyds Sta, Jas R Hughes ..... AM 6-2292
Det 20 Mich, 109 E Nine Mile Rd, T L Clinton ..... LI 7-0117
E Hartford 8 Conn, Box 282, Ralph A Sands ..... CH 7-4319
Greensboro N C, Box 2826, Max I Miller ..... BR 3-7955
Houston 4 Tex, 3011 San Jacinto St, C E Cotham ..... JA 2-0864
K C 3 Kans, 4306 Cambridge Ave, H F Ziegler Jr ..... JO 2-7352
L A 22 Cal, 5401 Telegraph Rd, O M Mac NaMa ..... RA 3-6211
Memphis 17 Tenn, 4711 Poplar Ave Rm 9, C L Wells ..... MU 5-8081
Milw 17 Wis, 5594 N Hollywood Ave, J W Smallshaw ..... WO 2-7570
Mpls 14 Minn, 215 6th St SE, E E Rempfer ..... FE 6-2828
N Y 17 N Y, 6 E 45th St, Harold D Hartman ..... OX 7-1050
Phila 44 Pa, 5823 Greene St, Richard J Zobel ..... VI 4-7085
Pgh 24 Pa, 4412 Liberty Ave, V E Hendrickson ..... MU 1-9333
Port 9 Ore, 738 NW Glisan St, C Curtis Conley ..... CA 8-4656
Roch 4 N Y, 217 E Ave, Robt L Wagner ..... HA 6-7953
St Louis 8 Mo, 4378 Lindell Blvd, Geo R McFarland ..... OL 2-0431
Salt L City 11 Utah, 461 E 2nd S St, W H Pingree ..... EM 3-6732
San Fran 7 Cal, 383 Brannan St, G O Johnson ..... SU 1-7997
Seattle 4 Wash, 1712 First Ave S, Edw A Hurley SE-0723
Tampa Fla, Box 1381, Harry Lindsey 2-1966

Stitt Ignition Company
Cal 1 O, 86 E First Ave, A R Brenholts, Pres ..... AX 9-5938
W J Bradley, Sales Mgr Southwest Div
Houston 25 Tex, 4117 Sarong Dr, W J Bradley ..... MO 5-7429

F J Stokes Corporation
Phila 20 Pa, 5500 Tabor Rd, F Dougherty Jr, Pres ..... CU 9-0100
Atlanta 19 Ga, 1678 Cross Keys Dr ..... CE 7-1684
Chi 45 Ill, 3058 W Peterson Ave ..... RP 4-8040
Cleve 15 O, 2036 E 22nd St ..... SU 1-7120
Dayton 29 O, 3070 Far Hills Ave ..... AX 8-6931
Mt Vernon N Y, Rm 302 26 E 1st St ..... MV 7-1705
Pasadena Cal, 15 N Euclid Ave ..... RY 1-8619
Phila 20 Pa, 5600 Tabor Rd ..... FI 2-8800
Port Conn, 252 Main St ..... DI 6-2601
Roch 20 N Y, 72 Lilac Dr ..... BR 1-1888
Union N J, 2165 Morris Ave ..... MU 8-2345

Stone & Webster Engineering Corporation
N Y 4 N Y, 90 Broad St ..... BO 9-4224

Stratford Engineering Corporation
K C 12 Mo, 612 W 47th St, D H Putney, Pres ..... LO 1-5030
C W Edmundson, VP-Eng Sales
Baton Rouge La, 635 Laurel St, Rawson & Co ..... DI 8-2868
Houston 19 Tex, 1223 Waugh Dr, Rawson & Co ..... JA 3-1696
L A 57 Cal, 2500 W 6th St, L Oberholtz Assoc ..... DU 8-1339
N Y 17 N Y, 60 E 42nd St, F J McConnell ..... YU 6-7266

A A Straub Company Incorporated
Cleve 11 O, 4930 Grayton Rd, A A Straub, Pres ..... WI 1-1114
N L Lamprecht, Sales Mgr
Houston Tex, 3513 W Dallas Ave, Frank M Neil ..... JA 9-3596

Stromberg-Carlson Company, Division General Dynamics Corporation
Special Products Div
Roch 3 N Y, 1400 N Goodman St, A G Schifino, VP-Genl Mgr ..... FI 2-8000
R B O'Brien, Genl Sales Mgr Spec Prods Div
Atlanta 8 Ga, 709 Spring St NW, P W Williams ..... TR 4-4557
Dallas Tex, 3202 Knox St, R E Gray ..... LA 8-3030
Det 35 Mich, 20131 Jos Couzens Hwy, J E Morrison ..... VE 8-5396
N Y NY, 507 Fifth Ave Rm 300, R Raymond ..... OX 7-8355

Struthers Wells Corporation
Warren Pa, Penna Ave W, H W Conarro, Pres 680
R J Reed, Genl Sales Mgr
A M Michell, Sales Mgr Tubular Equip Div
K Timm, Sales Mgr Mixing Equip Div
H Svanoe, Sales Mgr Crystallizer Equip Div
Akron 9 O, 850 S High St, B W Rogers Co ..... HE 4-4181
Albuquerque N M, 1609 Second St NW, Landes, Zachary 2-7761
Atlanta 5 Ga, 3133 Maple Dr NE, Walter C Davis 3-6346
Boston 10 Mass, 201 Devonshire St, Struthers Wells ..... HA 6-0790
Buff 2 N Y, 374 Del Ave, Struthers Wells Corp MA-4492
Chi 2 Ill, 6 N Mich Ave Rm 906, Struthers Wells ..... FI 6-4655
Cinn 8 O, 3181 Linwood Rd, Lathrop-Trotter Co ..... TR 1-2288
Cleve 15 O, 2036 E 22nd St, P M Kline ..... CH 1-1171
Denver 23 Colo, 275 Kalamath St, Landes, Zachary ..... MA 3-6203
Det 26 Mich, Kerr Bldg, Kerr Machy Co ..... WO 1-0590
El Paso Tex, 1900 Mills St, Landes, Zachary 3-9060
Houston 2 Tex, 675 Gulf Bldg, Tennant Co ..... CA 8-8454
Indpls 7 Ind, 4000 E 16th St, Lathrop Trotter Co ..... FL 6-8600
L A 4 Cal, 3319 Beverly Blvd, E M Underwood & Co ..... DU 2-1375
N Y 20 N Y, RCA Bldg Rm 4317, Struthers Wells Corp ..... PL 7-7272
Okla City Okla, 1824½ Linwood, Process Equip Co ..... CE 2-4757
Phila-Bala Cynwyd Pa, 29 Bala Ave, Struthers Well ..... MO 4-8146
Pgh 22 Pa, 2220 Farmers Bk Bldg, S W Goldsborough ..... GR 1-2921
St Louis 19 Mo, 331 Thornton Ave, Process Eng ..... WO 2-7771
Salt L City Utah, 153½ W 2nd South St, Landes, Zach ..... DA 2-0812
San Fran 16 Cal, 1022 Taraval St, E M Underwood & Co ..... MO 4-6306
Tulsa 16 Okla, 1141 E 15th St, Process Equip Co ..... WE 9-7334

Sumner Sollitt Company
Chi 1 Ill, 307 N Mich Ave, Sumner S Sollitt, Pres ..... ST 2-4459

Sun Shipbuilding and Dry Dock Company
Chester Pa, Morton Ave, Richard L Burke, Pres
Perry E Shaver, Sales Mgr

Superior Tube Company
Norristown Pa, Box 191, Clarence A Warden Jr ..... HU 9-7221
Henry B Brown Jr, Sales Mgr
National sales dist through Steel Warehouse Orgs

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Swartwout Company The
Cleve 12 O, 18511 Euclid Ave 1-0780
Charles J Swartwout, Div Mgr
M M Ward, Sales Mgr Autronic Proc Cont Div
Alhambra (LA) Cal, 317 Main St, Roger E Anthony ..... AT 1-3638
Chi 13 Ill, 1005 W Belmont, Robt E Budde ..... EA 7-5525
Decatur (Atlanta) Ga, 235 E Ponce de Leon, J Walchi ..... DR 7-1253
Denver 11 Colo, 2548 W 29th Ave, Howard S Ohl ..... GL 5-4766
Houston 2 Tex, 858 M & M Bldg, J B Downey ..... CA 4-6973
Jenkintown (Phila) Pa, 122 York Rd, Paul H Strahle ..... TU 4-3255
N Y 17 N Y, 103 Park Ave, Irving R Schwartz ..... MU 5-3561
Tulsa 3 Okla, 310 Thompson Bldg, S K Wilmont ..... LU 5-1923

T

Taber Instrument Corporation
N Tonawanda N Y, 111 Goundry St, R F Taber, Div Mgr LU-2626
L S Barker, Sales Mgr

Taylor Instrument Companies
Rochester 1 N Y, 95 Ames St, Raymond E Olson, Pres ..... GE 8-4800
L. Laurence Foward, Genl Sales Mgr

Tears Engineers
Dallas 5 Tex, 4617 Cole Ave, C F Tears, Pres ..... LA 6-7474

Technical Sales Corporation, Division Graphic Controls Corp
Det 35 Mich, 16599 Meyers Rr, E G Reindel, Pres ..... UN 4-8600
W L Jones Jr, Sales Mgr Tech Charts Inc Buff N Y
J P Hayward, Sales Mgr Staebler & Baker Inc Clay N Y
Alexandria Va, 123 N Fairfax, Wm S Wheeler ..... KI 8-9874
Birm 9 Ala, 1827 28th Ave S, Chas W Ashby ..... TR 9-9302
Buff 10 N Y, 189 Van Rensselaer St, W L Jones MA-6886
Chi 31 Ill, 6677 NW Hwy, John A Reindel ..... SP 4-1933
Cinn 2 O, 427 Temple Bar Bldg, E Ray Myers ..... DU 1-7783
Cleve 24 O, 29499 Bolingbrook Rd, J G Simpson ..... PR 1-4744
Det 35 Mich, 19599 Meyers Rd, Wm E Marsh ..... UN 4-8600
Englewood Fla, Box 788, N B Wilkes EN-3241
Houston 21 Tex, 5118 Winnetka Lane, Robt E Winters ..... MI 5-7516
Merion Sta (Phila) Pa, 618 Zollinger Way, J S McAdoo ..... WV 4-5008
Metairie (N O) La, Box 9275, R L Williams ..... VE 5-9417
N Y 7 N Y, 30 Church St, D V G Corwin ..... CO 7-3039
Omaha 3 Neb, 3120 N 45th St, M M Baker PL-4488
Pasa 1 Cal, 35 N Arroyo Pkwy, John L Courtois ..... TR 9-9302
Port 4 Ore, 317 Builders Exch Bldg, Bert W Farnes ..... CA 7-1766
St Louis 3 Mo, 2004 Locust St, John E Kindall ..... CE 1-6146
Salt L City 17 Utah, 4856 Boyes St, Blaine O Hebdon ..... CR 7-6721
Schenectady 9 N Y, 1425 Regent St, John D Govus ..... DI 6-1073
Seattle 2 Wash, 2426 42nd St N, Glenn O Carson FR-8347
Worchester 10 Mass, 787 Main St, Sterling Sales Co ..... WO 7-0800

Tellepsen Petro-Chem Constructors, Division Tellepsen Constr Company
Houston 1 Tex, Box 2536, Emory E Gose Jr, Vice Pres ..... WA 3 9331
Stafford H Wilde, Sales Mgr

Tennessee Corporation
Atlanta 1 Ga, 619 Grant Bldg ..... JA 3-5024
L S Kaniecki, Mgr Chem Sales Div

Texaco Development Corporation
N Y 17 N Y, 135 E 42nd Street

Texas Chemical Eng Company
Houston 4 Tex, 4101 San Jacinto, T L McNamara, Pres ..... VA 4-2214

Texas Metal Fabricating Company Incorporated
Houston 7 Tex, 7004 Old Katy Rd, E H Moss Jr, Pres ..... UN 2-6696
Bedford Harrison Jr, Sales Mgr

Texas Tank Incorporated
Dallas Tex, 3215 Hickory St, B R Sprayberry, Pres ..... HA 1-7111
James Garner, Sales Mgr

Thermal Research and Engineering Corporation
Conshohocken Pa, 400 Brook Rd, L C Peskin, Pres ..... TA 8-3580
W K Lambard, Sales Mgr
Cleve 21 O, 2195 S Green Rd, W Neundorfer ..... EV 2-0140

Thew Shovel Company The
Lorain O, 1374 E 28th St, C B Smythe, Pres ..... CH 4-1181
M B Garber, VP-Dir Sales
G E Gunther, Mgr Shovel & Crane Div
W H Madden, Sales Mgr Moto-Loader Div
F S Battin, Export Sales Mgr

Thompson-Ramo-Wooldridge Products Incorporated
L A 45 Cal, 5500 W El Segundo Blvd ..... OS 5-4651
Dr. Dean E Wooldridge, Pres
Dr. Joseph F Manildi, Genl Mgr
Raymond E Jacobson, Dir of Mrkg

Arthur Tickle Engineering Works Incorporated
Bklyn 31 N Y, 25 Delevan St, Arthur B Tickle Jr, Pres ..... MA 5-4200
Nicholas P Harvey, Sales Mgr Ind Div

Timken Steel and Tube Division, Timken Roller Bearing Company
Canton O, 1835 Dueber Ave SW, W E Umstattd, Pres ..... GL 3-4511
C H McCollam, Sales Mgr Steel & Tube Div
Birm 9 Ala, 10 Office Pk Circle, R G Harmon ..... TR 1-5172
Boston 16 Mass, 80 Boylston Ave, A E Hunt Sr ..... HA 6-5160
Buff 14 N Y, 2948 Main St, R R Hershey ..... MA -7905
Chi 32 Ill, 4647 W 47th St, J T Irwin ..... PO 7-7700
Cinn 29 O, 1738 Tenn Ave, J J McGrann ..... EL 1-1100
Cleve 20 O, 3605 Lee Rd Shaker Hts, S R Lyle ..... WY 1-6100
Det 2 Mich, 3107 W Grand Blvd, W J Brigham ..... TR 5-1380
Houston 6 Tex, 2472 Bolsover Rd Rm 247, R W Preston ..... JA 8-5416
Huntington 1 W Va, 422 Chafin Bldg, B M Tinlin 2-1260
L A 7 Cal, 2727 S Flower St, S R Kallenbaugh ..... RI 7-4141
Milw 16 Wis, 4444 W Cap Dr, M A Conley ..... HI 2-9444
N Y 38 N Y, 150 Bwy Rm 1607, R P Donnell ..... WO 2-1890
Pgh 13 Pa, 416 N Craig St, H D Robb ..... MA 1-7200
St Louis 10 Mo, 2100 S Vandeventer Ave, W F Anderson ..... MO 4-4724
Seattle 9 Wash, 305 9th Ave N, R F Baum MA-1580
Wash 6 D C, 823 Transp Bldg, R H Rowse ..... RE 7-6068
Boston 16 Mass, 80 Boylston Ave, A E Hunt Sr ..... HA 6-5160

Titeflex Incorporated
Springfield 4 Mass, Hendee St, Matthew J Botley, Pres ..... RE 9-5631
Dogan H Arthur, VP-Sales
Gordon J Wygant, Aviation Sales Mgr
A P Matolsy, Asst Ind Sales Mgr
Chi 32 Ill, 5175 Archer Ave, H J Peterson .....
Det 26 Mich, 641 Book Bldg, E C Frank .....
L A 15 Cal, 1824 S Hope St, L Williams ..... RI 7-9244
Newark 5 N J, 1060 Broad St, H A McGill .....
Springfield 4 Mass, Hendee St, G H Kinney ..... RE 9-5631

Toledo Pipe Threading Machine Company The
Toledo 4 O, 1445 Summit St, P C Cooke, Pres ..... CH 1-5175
C E Hartsing, Sales Mgr

Trane Company The
La Crosse Wis, 2nd & Cameron Ave 2-8000
Donald C Minard, Pres
Albany 7 N Y, 452 Bwy 4-8177
Albuquerque N M, 3217 Silver SE 6-0391
Allentown Pa, 1160 N 7th St ..... HE 5-9506
Amarillo Tex, Clowe & Cowan Inc, Box 551 ..... DR 2-3248
Appleton Wis, 217 W Lawrence St 4-4531
Atlanta 9 Ga, 2025 Peachtree Rd Office E ..... TR 5-7721
Aurora Ill, 33 Island Ave 6-9694
Balt 18 Md, 2 E 22nd St ..... BE 5-2456
Billings Mont, 403 N 24th 9-0269
Birm 3 Ala, 2008 8th Ave S ..... AL 4-3723
Boston 16 Mass, 31 St James Ave ..... LI 2-0235
Buff 9 N Y, 938 Ellicott St LI-7998
Canton 9 O, 2731 Cleve Ave NW ..... GL 6-7131
Charleston 22 W Va, 710½ Lee St ..... DI 6-1522
Charlotte N C, 101 Queens Rd ..... ED 4-6227
Chattanooga Tenn, 871 McCallie Ave ..... AM 7-6031
Chi 11 Ill, 341 E Ohio St ..... DE 7-1900
Cinn O, 2434 Central Pkwy ..... GA 1-6447
Clarksburg W Va, 117 N 4th St ..... MA 4-6501
Cleve 15 O, 2036 E 22nd St ..... TO 1-7251
Columbia S C, 2740 Devine St 3-5650
Col 2 O, 2901 N High St ..... AM 3-5475
Dallas Tex, 3114 Fairmont Ave ..... RI 1-9237
Davenport Ia, 613 Kahl Bldg 7-3297
Dayton 6 O, 627 Salem Ave TA-9767
Denver Colo, 603 12th St ..... AL 5-2814
Des Moines Ia, 6th & Walnut Sts ..... AT 8-5776
Det 27 Mich, 15370 Schaefer Hwy ..... BR 3-3500
Duluth 6 Minn, 2830 W Superior St ..... MA 4-1697
E Prov 1 R I, 1 Waterman Ave ..... GE 8-5100
Fargo N D, 320 Bwy 2-6232
Flint 3 Mich, 213 Mary St ..... CE 9-3141
Gainesville 4 Fla, 211 NW 27th St ..... FR 6-7116
Grd Rpds 2 Mich, 230 Ottawa Ave NW ..... GL 9-7288
Greensboro N C, 1414 Westover Terr 3-9424
Greenville S C, 644 E Stone Ave 5-3911
Harrisburg Pa, 2107 N 6th St ..... CE 4-1158
Houston Tex, 2223 Dorrington Blvd ..... MO 7-7437
Indpls 4 Ind, 635 N Penn St Rm 306 Plaza ..... ME 5-1409
Jackson Miss, 715 Electric Bldg 3-8412
Johnson City Tenn, 905 W Watauga Ave 3139
K C 11 Mo, 3527 Bwy ..... JE 1-8747
Knoxville 19 Tenn, 1933 W Cumberland Ave 2-9641
La Crosse Wis, 2nd & Cameron Ave 2-8000
Lansing 33 Mich, 521 N Wash Ave ..... IV 5-7616
Little Rock Ark, 12 Kavanaugh Pl ..... FR 6-1896
L A 11 Cal, 1978 S L A St ..... RI 8-6316
Louisville 2 Ky, 327 Fincastle Bldg ..... JU 2-2511
Mad 5 Wis, 2616 Univ Ave ..... CE 8-2473
Memphis 3 Tenn, 212 Adams ..... JA 6-0453
Miami 35 Fla, 2009 SW 1st St 9-1361
Milw 3 Wis, 1821 W Wells St ..... DI 2-9050
Nashville Tenn, Suite 412 1717 W End Ave Bldg ..... CH 2-0311
Newark N J, 439 Main St East Orange ..... GR 2-7384
N O 12 La, 348 Baronne St Rm 301 ..... EX-2358
N Y 17 N Y, 250 E 43rd St ..... MU 4-4628
No Tarrytown N Y, 95 Beckman Ave ..... ME 1-0493
Okla City 3 Okla, 1710 N Bwy ..... CE 2-1394
Omaha 3 Neb, 4308 Dodge St RE-0199
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Raleigh N C, 510 St Mary's St ..... TE 3-0896
Rich 21 Va, 3145-A A W Cary St 84-5018
Roanoke 12 Va, 3204 Williamson Rd ..... RD 6-3151
Roch 4 N Y, 328 Main St E HA-8506
Saginaw Mich, 2815 Reppuhn Dr ..... SW 2-7011
St Louis 9 Mo, 6510 Lansdowne Ave ..... VE 2-2543
St Paul 14 Minn, 850 Cromwell Ave ..... MI 5-4681
San Ant 5 Tex, 1819 Transit Tower ..... CA 6-9581
San Fran Cal, 1485 Bayshore Blvd ..... JU 6-3751
Seattle 1 Wash, 3010 First Ave SE-7966
Shreve La, Rm 1839 Line Ave Rm 101 5-3842
Sioux Falls S D, 2440 Kenwood Manor 2-6781
S Bend 1 Ind, 219 Christman Bldg ..... CE 4-4157
Spokane 1 Wash, 915 W Mallon ..... FA 8-3690
Syracuse 5 N Y, 1901 S Salina St ..... GR 5-4167
Tampa Fla, 305 N Morgan St 2-2135
Toledo 13 O, 4353 Monroe St ..... GR 5-3409
Trumbull Conn, 1 Hedgehog Rd ..... AM 8-1693
Tulsa 20 Okla, 1526 E 4th St ..... LU 4-4788
Wash 7 D C, 3121 S St NW ..... FE 3-2400
W Hartford 7 Conn, 1007 Farmington Ave Rm 3 ..... AD 3-8229
Wichita Kans, 1121 E Waterman ..... AM 5-9655
Wilkes-Barre Pa, 33 Bennett Bldg ..... VA 4-4691
Wilm 1 Del, 1318 Mrkt St ..... OL 8-4184
Worcester 8 Mass, 1125-A Main St Rm 23 ..... PL 4-8018

Tranter Manufacturing Incorporated
Lansing 9 Mich, 735 E Hazel St, J R Tranter, Pres ..... IV 4-4531
S J Stowell, Genl Sales Mgr
C W Loree, Sales Supr "Platecoil" Div
Atlanta Ga, 412 Walton Bldg, C E Johnson ..... JA 2-2632
Balt Md, 516 S Eutaw St, Tate Engrg Inc ..... LE 9-0787
Boston Mass, 1241 High Ave Needham Mass, W B Parsons ..... NE 3-4870

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Chi Ill, 444 N LaSalle St, Meters and Control Inc ..... WH 4-1448
Cinn O, 1720 Section Rd, Henry P Thompson Co ..... EL 1-3140
Cleve O, 2012 W 25th St, Glatte & Co ..... TO 1-0898
Clinton Ia, 208 Johannes Bldg, Meters & Controls ..... CH 3-2033
Dallas Tex, 4801 Lemmon Ave, G R Haley ..... LA 6-8363
Denver Colo, 847 E 17th Ave, Alldredge & McCabe ..... AL 5-7496
Det Mich, 718 New Center Bldg, Korest-Peterson Co ..... TR 2-0551
Grd Rapds Mich, 700 Monroe NW, Korest-Peterson ..... GL 8-2481
Hartford Conn, Post Off Bldg Avon Conn, Wm K Duff ..... OR 7-9175
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K C Mo, 4212 Main St, Hughes Machy Co ..... VA 1-7021
L A Cal, 5105 Telegraph Rd, Duhig & Co ..... AN 3-7161
Marietta O, 110 Knox St, Process Instr & Equip Co ..... FR 4-6767
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Pgh Pa, 940 Western Ave, W A Stoeltzing Inc ..... AL 1-9400
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San Fran Cal, 2802 10th St, Duhig & Co ..... TH 3-1670
Toledo O, 423 13th St, Skeldon Power Equip Co ..... CH 3-9516
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Union N J, 2165 Morris Ave, Gerald B Duff & Co ..... MU 6-1747

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W C Adams, Div Mgr
J E Stockton Jr, Sales Mgr
J R Moechel, Mgr Refinery Service Div
Casper Wyo, Box 315, L C Dessert 2-8861
Dallas Tex, 2301 Mercantile Bk Bldg, M J Mullally ..... RI 7-0764
Great Bend Kans, 1823 Wash, J B Robinson ..... GL 3-4082
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San Antonio Tex, 1902 Milam Bldg, C C Rogers Jr ..... CA 2-9871
Tulsa Okla, Box 2546, H S Horton ..... CH 2-1133
Wichita 18 Kans, 6427 E Kellogg, F L Kelley ..... MU 2-5558

Tretolite Company of California, Division of Petrolite Corporation
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L T Monson, Div Mgr
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D E Haines, Sales Mgr

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Edw M Feeley, Sales Mgr
Atlanta 13 Ga, 222 14th St NW, Abernathy-Thomas Eng
Baton Rouge La, Box 493, Paul-Condit Co
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Cleve 4 O, 3909 E 123rd St, Lester Johnson Co
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N Y (Roselle Pk N J) 481 Westfield Ave E, Trincar Corp
N Syracuse N Y, Box 248, O R Lawrence Co
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St Louis 17 Mo, 8701 Antler Dr, Bruce Greaves Co
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Seattle Wash, 761 Dexter-Horton Bldg, R H Brown & Co
Tulsa 19 Okla, 1011 S Main St, The Condit Co

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Conley O Kelsey, Sales Mgr

Tube-Kote Incorporated
Houston 25 Tex, 2727 Holmes Rd ..... JA 3-7313
E G Holm, VP-Genl Mgr
B J Ramey & Robt Riha, Sales Mgrs
Corpus Christi Tex, 442 Clifford St, W B Barton ..... TU 4-0873
Dallas Tex, 4734 Homer Apt G, J H Williams ..... TA 6-5000
Galveston Tex, 4723 Woodrow, Henry King ..... SO 3-4495
Houston Tex, 2727 Holmes Rd, John E Gilbert ..... JA 3-7313
Lafayette La, Box 1531, A A Prats Jr ..... CE 4-3663
Metairie La, 3205 Cypress Apt C, H D Bell ..... VE 3-1502
Midland Tex, 3805 Avondale Dr, R B Griffin ..... OX 4-1157
Shreve La, 700 Dodd Dr, Grady Howell 5-2717

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John E Chumbley Jr, VP-Sales
Atlanta 3 Ga, 1605 Atlanta Fed Sav Bldg, J F Craig Jr ..... JA 2-7310
Chi 5 Ill, 600 S Mich Ave, J C Ellsworth ..... HA 7-8526
Dallas Tex, Meadows Bldg Rm 309, W R Emrich ..... EM 8-7095
Denver Colo, 1160 10th St, V L Shallcross ..... CH 4-5807
Det Mich, 2591 W Grand Blvd, M L Maschek ..... TR 3-7938
Houston 1 Tex, 7120 Katy Rd, W B Whenthoff ..... UN 9-3531
K C Mo, 5019 W 55th St, Mission Kans, R A Hennier ..... WE 1-8111
L A 58 Cal, 2417 E 245th St, N P Bosemer ..... LU 7-8287
Midland Tex, 3209 Lockheed, Middleton DeCamp ..... MU 2-5743
N O La, 1205 St Charles Ave, E C Headley Jr ..... JA 5-1974
N Y 38 N Y, 150 Bwy Rm 2301, W P Curley ..... RE 2-8230
Phila 3 Pa, Suburban Sta Bldg Rm 1032, S M Hardison ..... LO 7-3218
Pgh 19 Pa, 1718 Grant Bldg, H P Smith ..... AT 1-8848
San Fran 4 Cal, 2611 Russ Bldg, D V Pisano ..... GA 1-2594
Seattle 5 Wash, 4001 45th Ave, R T Burke VE-2765
Tulsa 3 Okla, 704 Wright Bldg, L O Morris Jr ..... CH 2-9193

C A Turner Construction Company The
Houston 2 Tex, 1626 Bk of the SW Bldg, C A Turner, Pres ..... CA 7-2973
Port Arthur Tex, 3435 25th St, Willis Comeaux ..... YU 5-9642

U

Uhrden Incorporated
Dennison O, 508 Grant St, Kenneth L Cook, Pres 2485
R E DeCrane, VP-Sales

Union Carbide Chemicals Company, Division of Union Carbide Corp
N Y 17 N Y, 30 E 42nd St ..... MU 7-8000
Representatives in Principal Cities

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Representatives in Principal Cities

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Jos A E Hindman, Sales Mgr
Atlanta 5 Ga, 3105 Roswell Rd NE ..... CE 3-0306
Boston 16 Mass, 30 Huntington Ave ..... KE 6-0121
Buff 25 N Y, 54 Gruner Rd KE-8080
Chi 5 Ill, 600 S Mich Ave ..... HA 7-0977
Cleve 15 O, 1010 Euclid Bldg ..... TO 1-0612
Dallas Tex, 5526 Dyer St, W H Bolton ..... EM 1-2514
Denver 2 Colo, 1863 Wazee St, Edwin P Cook ..... KE 4-2371
Hopkins Minn, 621 E Excelsior Ave ..... WE 5-2300
Houston 2 Tex, 1607 Jeff Ave ..... CA 4-1236
L A 49 Cal, 11973 San Vicente Blvd ..... GR 2-9584
N Y 7 N Y, 1242 Woolworth Bldg ..... RE 2-3822
St Louis 10 Mo, 4115 Manchester Ave, R Wohlman ..... OL 2-5950

United States Hoffman Machinery Corporation
N Y 3 N Y, 103 Fourth Ave, Raymond Boyd Jr ..... OR 7-3600
C A Wallace, Sales Mgr Ind Filtration Div

United States Pipe and Foundry Company
Birmingham 2 Ala, 3300 First Ave N, Claude S Lawson, Pres 3-3161
Carl N Brown, Sales Mgr Pipe Div

United States Rubber Company
N Y 20 N Y, 1230 Avenue of the Americas ..... CI 7-5000
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Atlanta 2 Ga, 999 Lee St SW
Balt 5 Md, 500 N North Point Rd
(Boston) Mass, 100 Route 128 Dedham
Buff 3 N Y, 133 E Swan St
Chi 32 Ill, 4135 S Pulaski Rd
Cinn 37 O, 4921 Paro Dr
Cleve 3 O, 7208 Euclid Ave
Dallas 35 Tex, 1011 Regal Row
Denver 16 Colo, 4800 Colo Blvd
Det 16 Mich, 2121 W Fort St
Gastonia N C, 214 W Ruby Ave
Houston 17 Tex, 6654 Gulf Freeway
N Kans City 16 Mo, 16th & Swift Aves
L A 58 Cal, Soto & E 46th Sts, Mech Gds Div
L A Cal, 5901 Telegraph Rd, Naugatuck Chem Div
Memphis 7 Tenn, 1480 N Thomas St
Milw 5 Wis, 1314 N 7 St
Mpls 1 Minn, 400 Second Ave N
N O 25 La, 900 S Jeff Davis Pkwy
N Y 13 N Y, 191 Hudson St, Mechanical Goods Div
N Y 20 N Y, 1230 Ave of the Americas, Naugatuck Chem Div
Odessa Tex, 912 N Grant Ave
Okla City 5 Okla, 425 E Hill St
Omaha 2 Neb, 6847 N 16th St
Phila 6 Pa, 5th & Locust Sts
Phoenix Ariz, 1140 N 22nd Ave
Pgh Pa, Royal Dr-Graham St, McKees Rocks Pa
Port 9 Ore, 630 NW Tenth Ave
St Louis 2 Mo, 305 S Bwy
Salt L City 15 Utah, 1967 S 2nd West St
San Fran 24 Cal, 6025 3rd St
Tulsa 4 Okla, 1132 S Lewis Ave

United States Steel Corporation
Pgh 30 Pa, 525 Wm Penn Pl ..... EX 1-2345
Balt 2 Md, 200 St Paul Pl
Boston 16 Mass, 1420 Statler O..ce Bldg
Buff 2 N Y, 424 Main St
Chi 90 Ill, 208 S LaSalle St
Cinn 1 O, 4th & Walnut Sts
Cleve 14 O, 526 Superior Ave
Det 2 Mich, 3044 W Grand Blvd
Hartford 3 Conn, 37 Lewis St
Indpls 4 Ind, 320 N Meridian St
K C 5 Mo, 2706 Power & Light Bldg
N Y 6 N Y, 71 Broadway
Phila 3 Pa, 1617 Penna Blvd
St Louis 3 Mo, 1221 Locust St
St Paul 1 Minn, 334 Minnesota St

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Akron 9 O, Tallmadge Ave, J M W Chamberlain, Pres ..... ME 3-3224
Howard Farkas, VP-Genl Sales Mgr
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Houston 4 Tex, 4101 San Jacinto, S B Craig ..... JA 8-3209
L A 22 Cal, 908 S Atlantic Blvd, Ken Bullock ..... AN 8-3000
N Y 17 N Y, 60 E 42nd St, H Farkas ..... MU 2-6577

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

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Boston 16 Mass, 20 Prov St Rm 1027, B J Whittaker ..... HU 2-2444
Chi 4 Ill, 208 S LaSalle St, W R Doolittle ..... ST 2-9300
Dayton 2 O, 32 N Main St, D H Deacon MI-9681
K C 6 Mo, 928 Grand Ave, W M Tomlinson ..... BA 1-5530
Milw 2 Wis, 208 E Wis Ave Rm 1236, Harold Meyer ..... BR 6-2154
Mpls 2 Minn, 527 Marquette Ave, P L Bowlin ..... FE 3-0324
Phila 3 Pa, 1617 Penna Blvd Rm 1283, R E Fulton ..... LO 4-4626
Pgh 30 Pa, 525 Wm Penn Pl, L V Walsh ..... EX 1-2345
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Des Plaines Ill, 30 Algonquin Rd, M P Venema, Pres ..... VA 4-1155
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Davis Read, Mgr Comm Dev Dept
W W Johnstone, Mgr Product Sales Dept
(Chi) RO 3-6000

Universal Packing and Gasket Company
Houston 20 Tex, 5210 Clinton Dr, A J Pippert ..... OR 2-8321
E B Heathcott, Sales Mgr

V

Van Der Horst Corporation
Olean N Y, 1660 E State St, J M A Van Der Horst, Pres 3173
Chi 16 Ill, 2610 S Shields, F Jorstad ..... CA 5-1268
Terrell Tex, K Van Der Horst ..... JO 3-4457

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Dana B Griffin, Sales Mgr
Representatives in Principal Cities

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A E Kallinich, Vice Pres
G L Logan, Sales Mgr Counting Devices Div
Chi 6 Ill, 549 W Wash Blvd, C C Lombardi ..... ST 2-6283

Vernon Tool Company Limited
Alhambra Cal, 1101 Meridian Ave ..... CU 3-1206
Representatives in Principal Cities

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Eliz N J, Box 509, R W English, Pres ..... EL 4-2141
J E St Clair, VP-Sales Mgr
Casper Wyo, 208 N Mrkt St, S D Chilcote ..... CA 3-4573
Houston Tex, 6006 Harvey Wilson Dr, G N LaMont ..... WA 6-2689
L A Cal, 2330 E 8th St, H D Squibb TR-9948
Odessa Tex, Box 3444, M R Huffman ..... FE 7-6398

Viking Pump Company
Cedar Falls Ia, 4th & Handrup Sts, R C Wyth, Pres ..... CO 6-1741
Stanley A Petersen, Sales Mgr
Atlanta 13 Ga, 1223 Techwood Dr NW, C W Downing ..... TR 5-7131
Chi 6 Ill, 549 W Wash Blvd, C W Dennis ..... ST 2-6818
Dallas 22 Tex, 2175 W Commerce St, O W Phillips ..... RI 2-6839
Cleve 13 O, 310 Marshall Bldg, J A Sinden ..... CH 1-0687
Indpls 25 Ind, 417 Mad Ave, C D Sadler ..... ME 4-3463
Milw 3 Wis, 610 Mich St, C F Mullens ..... BR 6-0807
Overland Pk Kans, 7113 W 79th St, F J Pinney ..... NI 2-6023

Vinson Supply Company
Tulsa Okla, 220 N Boston, B W Vinson, Pres ..... LU 7-6671
Louis O Barnett, Sales Mgr
Amarillo Tex, 655 N Fairchild, B J Enlow ..... DR 4-2805
Dallas Tex, 4606 Singleton Blvd, T M Jarman & W O Jones ..... FE 1-4311
Farmington N M, 2616 Main St NE, L A Witherspoon ..... DA 5-3602
Houston Tex, 1211 Kress St, J H Heinzerling ..... WA 8-5181
K C Mo, 6305 Brookside Plaza, J J Joyce ..... EM 1-5475
Odessa Tex, 1609 W 2nd St, B E Keeling ..... FE 2-4351
Okla City Okla, Classen Ter Bldg Rm 112, F McDannold ..... JA 5-0539
Tulsa Okla, 220 N Boston, T B Lowary ..... LU 7-6681

Visco Products Company, Division National Aluminate Corporation
Houston 25 Tex, 1020 Holcombe Blvd, J A Holmes, Pres ..... JA 8-2495
K L Russ, Mgr Refinery Div
Hammond Ind, 1011 175th St, R D Beer ..... WE 1-7279
Wilm 5 Del, 1418 Spruce St Oak Hills, W O Slaughter ..... WY 4-4790

Visking Company, Division of Union Carbide Corporation
Chi 38 Ill, 6733 W 6th St ..... RE 5-1234

Henry Vogt Machine Company
Louisville 10 Ky, 1000 W Ormsby, Henry V Heuser, Pres ..... ME 4-9411
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Melvin Sack, Sales Mgr Heat Exchangers Div
L E Baumgarten, Sales Mgr Refrig & Ice Machines Div
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Charleston W Va, Box 1522, Gardner Pass ..... PL 5-2671
Chi 3 Ill, 111 W Monroe St, E G Staley ..... FR 2-3273
Cleve 14 O, 710 Williamson Bldg, R C Barth-J W Dugan ..... PR 1-3033
Dallas Tex, 311 S Akard St, J L Massie ..... RI 1-9476
N Y 4 N Y, 80 Broad St, R Woolf, W Bisch ..... BO 9-3668
St Louis 17 Mo, 6611 Clayton Rd, W Wheeler-L Stickler ..... PA 5-1200

Vortex Company
Claremont Cal, 121 S Alex Ave, C C Edinger, Genl Mgr ..... LY 6-1283
G S Walker, Sales Mgr
Chi 49 Ill, 201 N Wells, C L Sherman ..... FI 6-1946
Claremont Cal, 121 S Alex Ave, S T McCormick ..... LY 6-1283
Willoughby O, RD 4 Berkshire Hills Dr, R H Edwards ..... WH 2-3517

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N Y 54 N Y, 785 E 144th St, Mrs A C Voss, Pres ..... ME 5-9442
Karl W Schartel, Sales Mgr

Vulcan-Cincinati Incorporated
Cinn 2 O, 120 Sycamore St, T O Wentworth Pres ..... DU 1-1400
W D Beers, M W Swetland, Asst Mgrs Eng Div
R A Menges, Mgr Construction Div
R F Romell, Mgr Mfg Div

Vulcan Steel Tank Corporation
Tulsa 16 Okla, 3207 Dawson Rd, Charles A McNamar, Pres ..... MA 6-1118
Jas L McNamar, Sales Mgr Process Equip Div
Wayne G Pigman, Sales Mgr LPG Div
William Hayes, Sales Mgr Boiler Div
C F Koenig, Sales Mgr Furnaces & Heaters Div

W

E H Wachs Company, Pipe Saw Division
Chi 22 Ill, 1525 N Dayton St, E H Wachs, Pres ..... MI 2-4650

Walco Engineering & Construction Company
Tulsa 8 Okla, 2408 E 4th Pl, Paul C Wallack, Pres ..... MA 6-2136

Walsh Refractories Corporation
St Louis 7 Mo, 101 Ferry St, A J Tomasek, Pres ..... GA 1-3272
W K Schweickhardt, VP-Sales Mgr Refractory Sales
C W Morgenaler, Supr Sales Div
Chi 3 Ill, 176 W Adams, C F Ebert ..... CE 6-0031
Ft Smith Ark, 3600 S Boston, Mm Hegmann Jr ..... SU 3-1212
Indpls 24 Ind, 2113 Allison, C A Schindler ..... CH 4-2787
K C 13 Mo, 3807 73rd Terrace, W J Kamiski ..... EN 2-4839
Mpls 8 Minn, 3208 Irving Ave S, A D Edwards ..... TA 2-6533
Moline Ill, 1103 40th St, S R McCord ..... MO 4-0764
Purvis Miss, Box 304, Richard Davis ..... SW 4-2483

Walworth Company
N Y 17 N Y, 750 Third Ave, F W Belz, Pres ..... MU 2-7060
Atlanta 18 Ga, 1600 Southland Circle NW ..... SY 4-9536
Boston 4 Mass, 430 Summer St ..... HA 6-0650
Boston 27 Mass, 800 First St
Camden 3 N J, 300 Broadway ..... WO 3-1689
Chi 23 Ill, 4500 W 31st St ..... FR 6-6464
Cleve 14 O, 1110 Fidelity Bldg
Dallas 1 Tex, 708 Davis Bldg ..... RI 7-8048
Det 2 Mich, 703 Stephenson Bldg
E St Louis Ill, 2133 Bond Ave
Greensburg Pa, Huff Ave
Harrison N J, 400 S Second St ..... HU 3-5600
Houston 23 Tex, 3503 Polk Ave ..... CA 8-4441
Kewanee Ill, Elm & E 3rd Sts
L A 22 Cal, 2655 S Eastland Ave ..... RA 3-6191
Mineola N Y, 89 Union St
Pgh 19 Pa, 602 Frick Bldg ..... AT 1-8745
San Fran 4 Cal, 155 Montgomery St ..... GA 1-3950
Seattle 4 Wash, 107 Cherry St EL-0822
Tulsa Okla, 321 Enterprise Bldg
Wash 6 D C, 1625 Eye St NW

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T R Bradley, Sales Mgr
Chi Ill, 6642 W North Ave, Warner Lewis Jr ..... BI 7-3532
N Y 17 N Y, 489 Fifth Ave, M A Phillips ..... OX 7-7269

Warren Pumps Incorporated
Warren Mass, 571 Bridges Ave, D B Gilman, Exec VP ..... HE 6-7711
W B Eklund, Sales Mgr Ind Div
Appleton Wis, 913 E College Ave, F A Janson ..... RE 4-4284
Atlanta Ga, 3551 Ivy Rd NE, S C May ..... CE 7-1162
Balt 2 Md, 100 E Pleasant St, J F Murray ..... SA 7-0419
Battle Creek Mich, 1105 Sec Natl Bk Bldg, W J Inwood ..... WO 4-1461
Boston 10 Mass, 80 Federal St, P A Collins ..... HA 6-1433
Buff 21 NY, 100 Kimberly Rd, R O Dale PL-7111
Chi 10 Ill, 444 N LaSalle St, T G Robinson ..... WH 4-1448
Cinn 12 O, 4200 Mont Rd, G Collins ..... EL 1-4935
Cleve 20 O, 3494 Lee Rd, A T Miller ..... WA 1-5580
Clinton Ia, 300 S 2nd St, L C Knockel ..... CH 3-2033
Denver 2 Ia, 1542 Blake St, B G Downs ..... TA 5-2885
Det Mich, 2970 W Grand Blvd, W J Inwood ..... TR 5-5721
Houston 2 Tex, 675 Gulf Bldg, J E Walsh ..... CA 8-8454
L A 15 Cal, 947 S Grand, G Moore TR-8287
N O 15 La, 1719 Toledano St, A W Betz ..... TW 5-8691
N Y 7 N Y, 30 Church St, H W Gilson ..... CO 7-0517
Phila 23 Pa, 446 N 12th St, J A Nibling ..... LO 3-2338
Pgh 19 Pa, 524 Grant Bldg, R E Nelson ..... CO 1-4432
Rich 19 Va, 615 E Franklin St, I R Berkness 3-5357
San Fran 5 Cal, 100 Howard St, J E Swett ..... EX 2-6145
Seattle 1 Wash, 1218 3rd Ave, R L Dyer MA-3441

Water Cooling Equipment Company
St Louis 23 Mo, 8601 New Hamp, W G Drosten Jr, Pres ..... FL 3-3600
Eugene Bass, Sales Mgr

Weksler Instruments Corporation
Freeport L I NY, 195 E Merrick Rd, E P Dabrin, Pres ..... MA 3-0100
F J Pia, Sales Mgr
Albany N Y, Box 974, Avery M Walsh & Sons 4-7406
Atlanta 3 Ga, 314 Buckhead Ave NE, Thermal Engrg Co EX-8664
Austin Tex, 300 W 8th St, J R Dowdell & Co ..... GR 2-3139
Balt 18 Md, 330 E 25th St, Shanklin Co ..... BE 5-6183
Birm Ala, 3110 Clairmont Ave, Palmer & Lawrence 53-1543
Boston 16 Mass, 258 Park Sq Bldg, Carr Bros Co ..... LI 2-1326
Buff 11 N Y, 1622 Fillmore Ave, J V Tripoli & Co BA-1777
Charlotte N C, 715 W Morehead St, Kirk Cousart & Assoc ..... FR 5-7737
Cinn 36 O, 6809 Stewart Rd, McLean-Peterson Co ..... TW 1-1570
Cleve 26 O, 21085 S Park Dr, Jos N Novak Co ..... ED 1-7606
Corpus Christi Tex, 525 Glazebrook St, J R Dowdell ..... UL 2-8271
Dallas Tex, 4024 Swiss Ave, J R Dowdell C Co ..... TA 3-9901
Denver Colo, 1715 York St, L A Christopher Co ..... FL 5-7335
Des Moines 15 Ia, 3609 Wakonda Dr, W W Stuart ..... CH 3-7338
Det 38 Mich, 15770 Wyoming, A A Treadway Inc ..... DI 1-8709
Durango Colo, 1474 N Main St, L A Christopher Co ..... CH 7-0927
Ft Worth Tex, 600 Bailey St, J R Dowdell & Co ..... ED 2-9364
Evanston Ill, 933 Sherman Ave, Garden City Instrs ..... SH 3-4450
Greensboro N C, 1882 Pembroke Rd, Kirk Cousart ..... BR 5-8559
Greenville S C, 511 S C Natl Bk Bldg, Kirk Cousart 2-9513
Houston Tex, 714 Bastrop, J R Dowdell & Co ..... CA 4-9616
Indpls Ind, 1842 Central Ave, C C Schuetz Inc ..... WA 5-3523
Louisville Ky, 303 Chenoweth Lane, Homer Frost ..... GW 6-6470
Lubbock Tex, 3608 Ave "A", J R Dowdell & Co ..... SH 4-2388
K C Mo, 112 W 18th St, Mid-States Supp Co VI-4290

Advertisement in this issue. index is on page A-6.

COMPANY DIRECTORY

L A 23 Cal, 1218 S Bayle Ave, Instr Serv Co ..... AN 1-4154
Milw 8 Wis, 5531 W North Ave, Donald E Riley & Co ..... UP 1-9570
Omaha Neb, 1346 S 20th St, Midco Supp Co HA-2226
Pensacola Fla, 1826 N Pace Blvd, Mfgs Sales Co
Phila 4 Pa, 101 N 33rd St, Geo F Bertrand Co ..... BA 2-8015
Phoenix Ariz, 1325 S 26th St, Cone & Wallace Co ..... BR 5-4406
Pgh 33 Pa, 940 Western Ave, Forbes-Western Inc ..... AL 1-9400
Port 15 Ore, 6019 NE Union, Branom & Leeland Instr AT-1-1136
Rich Va, 207 N Laurel St, H M Summerell & Co 86-0559
St Louis 5 Mo, 6953 Olive St Rd, C W Baker ..... PA 5-2880
Salt L City Utah, 1361 Stratford Ave, Wayne Wiscomb 84-1662
San Antonio Tex, 722 W Hildebrand, J R Dowdell & Co ..... PE 5-6124
San Fran 5 Cal, 256 Mission St, Pacific Coast Instr ..... SU 1-3181
Seattle 1 Wash, 2137 2nd Ave, Branom & Leeland Instr MA-7320
Shreve La, 2908 E Cavett, Richard L Johnson Jr 8-7898
Spokane 2 Wash, 120 N Div St, Ind Instr Supp ..... RI 7-2031
Syracuse N Y, 600 Parsons Dr, Avery M Walsh & Sons 2-5687
Tampa 2 Fla, 1605 Franklin St, O H Howell, Mfgrs Agent 2-6783
Tulsa 3 Okla, 905 Daniel Bldg, Flow Meas Co ..... TU 3-5080
W Jackson Miss, Box 2324, Gene Ariedge Co Inc 4-2761
Wichita Kans, Box 992, Mid-States Supp Co ..... AM 5-9541

Welding Fittings Corporation
Newcastle Pa, Flowline Rd, Allan W Beatty, Pres ..... OL 4-5541
S C Carrier, VP-Sales
Roger G Brown Jr, Asst Sales Mgr
L A 22 Cal, 4781 E 3rd St, Howard W McNutt ..... AN 8-3717
N Y 7 N Y, 233 Bwy, David D Warfel ..... WO 2-6669

West Instrument Corporation
Chi 41 Ill, 4363 W Montrose Ave, Wm C West Jr ..... PA 5-1007
Ardmore M Willer, Asst Sales Mgr
Albuquerque N M, 1609 2nd St NW, Landes, Zachary 2-7761
Atlanta 5 Ga, 111 Tuxedo Terr NW, Lewis M Crowe Co ..... CE 7-9209
Berkeley Cal, 2722 Russell St, Herron Engrg Co ..... TH 8-5972
Boston 15 Mass, 1018 Commonwealth Ave, Gibson Engrg ..... AS 7-5074
Buff 2 N Y, 505 Delaware Ave, Niagara Elec Sales Co SU-4000
Charlotte N C, 737 Prov Rd, Jas L Hightsmith & Co ..... FR 7-2546
Chi 30 Ill, 4734 N Austin Ave, Warner Inst & Sales Co ..... PE 6-3758
Cleve 11 O, 3519 W 117th St, Instr Serv & Equip ..... OR 1-4102
Dallas 4 Tex, 3403 McKinney Ave, Esch & Assoc ..... LA 6-3901
Dearborn Mich, 2210 N York St, Ind Temp Cont Co ..... CR 8-2210
Denver 23 Colo, 275 Kalamath St, Landes, Zachary ..... MA 3-6203
El Paso Tex, 1900 Mills St, Landes, Zachary 3-9060
Ephraim Wis, W C West ..... SB 4-2522
Falls Church Va, 1107C W Broad St, S S Lee Assoc ..... JE 4-3500
Gary Ind, 537 Penna St, W J Collins Steel & Spec Co ..... TU 3-1008
Grd Junct Colo, 2701 S Hwy 50, Landes, Zachary 1609
Hammond Ind, 6346 Columbia, Ray Welch Co ..... WE 2-4474
Hartford Conn, 141 Wash St, Gibson Engrg Co ..... CH 7-6919
Houston 11 Tex, Box 9361, Esch & Assoc ..... WA 8-3357
K C 13 Mo, 131 E 70th St, Jack M Gilbert Co ..... DE 3-8830
L A 47 Cal, 1836 W Florence Ave, Instr Laboratory ..... PL 2-4104
Madeira O, 7706 Shawnee Run Rd, Engrg Specialties ..... LO 1-6803
Miami 42 Fla, 4101 NW 29th St, Barfield Instr Corp ..... NE 4-9771
Mpls Minn, 1645 Hennepin Ave, Wood Clemons Co ..... FE 9-0707
Newark N J, 1060 Broad St, Norman Bragar Co ..... MA 3-3156
N O 13 La, 1050 Constance St, Electron Engrg Co RA-5204
Port 11 Ore, 6019 NE Union Ave, Branom & Leeland Inst EA-5214
Riverside N J, 571 Fairview St, Gamble Bros ..... HO 1-4068
Roch 4 N Y, 133 S Clinton, Niagara Elec Sales Co HA-2070
Salt L City Utah, 153½ W 2nd South St, Landes, Zachary ..... DA 2-0812
Seattle 1 Wash, 2137 2nd Ave, Branom & Leeland Inst MA-7320
Tulsa 3 Okla, 28 N Guthrie, Paul King Co ..... CH 2-4478
Univ City 5 Mo, 6267 Delmar Ave, Edw W Mooney ..... PA 5-4271
Wilkinsburg Pa, 822 Wood St, Earl E Whitaker & Son ..... FR 1-6220

Western Gear Corporation
Lynwood Cal, 2600 E Imperial Hwy, B J Bannan ..... NE 6-0911
R L Conlisk, Sales Mgr Ind Div
Chi 3 Ill, 122 S Mich Ave, J B Post ..... WA 2-3275
Dallas Tex, 500 S Ervay St Rm 335, E W Jenks ..... FL 7-1970
Denver 3 Colo, 865 Lincoln St, R W Ritzel ..... KE 4-5513
Houston 3 Tex, 117 N Palmer St, C E Bennett ..... CA 8-4466
L A Cal, Box 192, J J Sullivan ..... NE 6-0911
Port Ore, 930 SE Oak St, C C Harshberger ..... BE 5-3177
San Fran Cal, 1035 Folsom St, P H Marmont ..... HE 1-6521
Seattle 4 Wash, 417 9th Ave S, R B Worl MA-0066
Wash D C, 830 Wash Bldg, K A Ayers ..... ST 3-3948

Western Supply Company
Tulsa 1 Okla, 424 N Boulder ..... LU 5-8211
M C Jacobs, VP-Sales Eng Supply Div
Greggton Tex, Box 414, Jake Reed ..... PL 9-2181
Houston Tex, 631 San Jacinto Bldg, Paul Evershade ..... CA 4-0665
Pampa Tex, Box 2022, Luther Gise ..... MO 4-6818
Tyler Tex, Box 684, Nate Davis 4-4232
E W Flaxbart, Sales Eng Heat Exch Div
H J Danne, Sales Eng Heat Exch Div
D E Schirmer, Sales Eng Heat Exch Div
Amarillo Tex, Box 3151, Wayne Griffiths-Hudson Rush Co ..... DR 3-6441
Dallas Tex, 130 Casa Linda Plaza, Jack W Rush ..... DA 1-6471
Louisville Ky, 2416 Frankfort Ave, H W Saverance
Shreve La, 753 Gladstone Blvd, Morley A Hudson 8-8441

Westinghouse Electric Corporation
Pgh 30 Pa, Box 868, Mark W Cresap, Pres ..... EX 1-2800
Representatives in Principal Cities

Weston Electrical Instrument Corporation
Newark 12 N J, 614 Frelinghuysen Ave, E R Mellon, Pres ..... BI 3-4700
W H Steinkamp, Sales Mgr
Buff 2 N Y, 130 W Chippewa St MO-5243
Chi 6 Ill, 205 W Wacker Dr Rm 1222 ..... FR 2-4656
Cinn 37 O, 7613 Reading Rd ..... VA 1-9105
Dayton 2 O, 11 W Monument Ave HE-8164
Det 21 Mich, 16607 Jas Couzens Hwy ..... DI 1-2121
L A 7 Cal, 2001 S Grand Ave ..... RI 9-2361
N Y 7 N Y, 50 Church St Rm 1775 ..... WO 4-3510
Phila 4 Pa, 101 N 33rd St ..... BA 2-6458
San Fran 3 Cal, 147 10th St ..... UN 3-4250
Union N J, Rt 22 & Caldwell Ave ..... MU 8-2020
Wash 4 D C, 425 13th St NW ..... DI 7-3636

Westvaco Chlor-Alkali Division, Food Machinery and Chemical Corp
N Y 17 N Y, 161 E 42nd St, Fred A Gilbert ..... MU 7-7400
A F Smith - P F Tinsley, Sales Mgrs, Chlor-Alkali Div
Charlotte N C, 1207 Lib Life Bldg, W M Clark ..... CH 7-1521
Chi Ill, 6 N Mich Ave, J R O'Neill ..... FL 1-2618
Denver Colo 218 Majestic Bldg R W Van Orsdel ..... AC 2-7858
N Y NY, 161 E 42nd St, W O Holleman ..... MU 7-7400
Phila Pa, 3701 N Broad St, F G Seegers ..... AT 1-8979
S Charleston W Va, 211 Research Bldg, R M Hoyer ..... CH 4-9431

Westvaco Mineral Products Division, Food Machinery and Chemical Corporation
N Y 17 N Y, 161 E 42nd St, W N Williams ..... MU 7-7400
J R Harris, Sales Mgr Min Prods Div
Chi Ill, 6 N Mich Ave, R E Purcell ..... FI 6-2126
Cinn 2 O, 1101 Gwynn Bldg, J A Lewis MA-5979
Houston 25 Tex, 6910 Fannin Rm 322N, P K Mooney ..... JA 4-7425
Newark Cal, A L Diebolt ..... NE 3-3611
N Y 17 N Y, 161 E 42nd St, A G Tappin ..... MU 7-7400
Phila Pa, 3701 N Broad St, G W Lewis ..... BA 3-7901

Wheaton Brass Works
Union N J, Springfield Rd, E W Wheaton, Pres ..... MU 6-1120
W J Schultz, Sales Mgr

Wheeling Machine Products Company
Wheeling W Va, V E Cornell, Pres ..... CE 2-0175
J W Taylor, Sales Mgr
Balt Md, 2301 N Chas St, Jas W Frankhanel
Chi 5 Ill, 1090 Old Colony Bldg, Harry A Jay ..... WA 2-6189
Denver Colo, 1863 Wazee St, Earl H Jones Co ..... AL 5-3162
Erie Pa, Box 714, R J Maggi 3-1425
Falmouth Mass, 5 Belvedere Rd, W S Bennett ..... KI 8-2489
Grd Rpds 7 Mich, Box B-12, R W Lang Jr ..... CH 1-3991
Houston Tex, Box 932, Henry H Paris Dist Inc ..... CA 5-0141
Independence Mo, 3701 Norwood, Craig A Fross ..... CL 2-4157
Lg Is City 1 N Y, 11-05 38th Ave, Max Rothenberg Co ..... EX 2-1500
L A 21 Cal, 1400 Santa Fee Ave, Jas A Riordan Co of LA TR-6543
Louisville 1 Ky, Box 1336, Sid Schultze Co ..... JU 4-5466
Milw 16 Wis, 3347 N 97th St, W G Nelson ..... HO 2-0220
Narberth Pa, 105 Forrest Ave, J W Worthington ..... MO 4-2932
N Y NY, 50 Cliff St, Henry Stein ..... BE 3-1738
Omaha 4 Neb, 5101 Blondo St, Cent States Engrg & Sls GL-3803
Port Ore, 1233 NW 12th Ave, Earl H Jones & Co ..... CA 7-2611
Rich 19 Va, 15 E Franklin St, P C Abbott & Co 3-0151
Salt L City 11 Utah, 29 E 2nd St, Earl H Jones & Co ..... EL 9-3024
Seattle 9 Wash, 819 Thomas St, Earl H Jones & Co SE-2181
St Louis 20 Mo, 4869 Goodfellow Ave, W C Dollinger ..... EV 5-1717
Tuscon Ariz, 3319 N Bentley Ave, Blaine M Moke
Woodlake Cal, Cal-Wheeling Mach Products Co ..... JO 4-3361

J G White Engineering Corporation The
N Y 4 N Y, 80 Broad St, Dudley F Phelps, Pres ..... BO 9-8600
G H O'Sullivan, VP-Sales

Whiting Corporation
Harvey Ill, 157th & Lathrop, J A Handley, Pres ..... ED 1-4000
A M Truc, Sales Mgr
Charlotte 2 N C, Lib Life Bldg, F W Fisher ..... ED 4-5346
Chi 3 Ill, 33 S Clark St, R S Hammond ..... FR 2-5303
Cinn 8 O, 3181 Linwood Rd, M E Johnson ..... TR 1-1589
Cleve 13 O, 617 Penton Bldg, A C Kukral ..... CH 1-0850
Det 35 Mich, 18505 Jas Couzens, M R MacGuidwin ..... UN 3-0975
Houston 5 Tex, 2480 Times Blvd, E C Brown ..... JA 9-5578
N Y 7 N Y, 30 Church St, H B Caldwell ..... RE 2-9655
Norwalk Cal, 14420 S Bloomfield, A R Binckes ..... UN 4-2776
Phila (Ardmore) Pa, 9 Rittenhouse Pl, G M Dennis ..... MI 2-8100
Pgh 22 Pa, 1109 Empire Bldg, H E Reynolds ..... AT 1-4846
Seattle 1 Wash, 529 Skinner Bldg, R E Florine MU-1785
Univ City 5 Mo (St Louis) 567 N & South Rds, F Walsh ..... VO 3-6600

Whitlock Manufacturing Company
W Hartford 10 Conn, South St (Elmwood) ..... JA 2-4293
W C Beckley, Pres
A J Jackson, Sales Mgr
Boston 8 Mass, 6 Beacon St, E J Parent ..... CA 7-8680
Chi 5 Ill, 407 S Dearborn St, A L Watson ..... HA 7-8944
N Y 6 N Y, 149 Bwy, C J Wahl ..... CO 7-8217
Phila 3 Pa, 2206 Chestnut St, S T Green ..... RI 6-0863

Wickes Boiler Company, Division of The Wickes Corporation
Saginaw Mich, 515 N Wash Ave, D H Barnes, Div Pres ..... PL 7-0411
C S Thorson, Dist Sales Mgr
Chi Ill, 205 W Wacker Dr, M L Langschwager ..... DE 2-4834
Det Mich, 414 New Center Bldg, R L Sauer ..... TR 5-1419
Milw Wis, 1327 First Wis Natl Bk Bldg, Ralph Melvin ..... BR 2-3159
N Y NY, 501 Fifth Ave Rm 1101, R L Roesener ..... MU 7-6860
Tulsa Okla, 1314 S Boston, O S Hubbard ..... LU 7-2684

Gustav Wiedeke Company The
Dayton 1 O, 1833 Richard St, F J Hollencamp, Pres ..... CL 3-6133
R B Pleiman, Genl Sales Mgr

Wilbur & Williams Company
Brighton 35 Mass, 130 Lincoln St, Merton E Williams ..... ST 2-1700
Geo P Allen, Sales-Service
Thomas A Durkee, Sales Mgr Eastern Div

A R Wilfley and Sons Incorporated
Denver 1 Colo, Box 2330, Elmer R Wilfley ..... MA 3-4335
Geo M Wilfley, Sales Mgr
N Y 17 N Y, 122 E 42nd St, J P Bonardi ..... MU 2-0278

T D Williamson Incorporated
Tulsa 9 Okla, 2733 E Latimer St, T D Williamson, Pres ..... WE 9-5416
O E Thompson, Sales Mgr
Amarillo Tex, Box 548, Jas S Kone & Co
Bartlesville Okla, 809 Osage, E O Owens 4807
Houston Tex, 2525 S Blvd, Tod Pazdral Pipe Line Spec
Jackson Mich, Box 365, F B Crandall ..... ST 2-8044
Joliet Ill, Box 913, F E Zongker 6-2953
Pasadena Cal, 130 Sequoia Dr, R M Riddell Co
Plainfield N J, Box 347, Stuart Steel Protn Corp
Pgh 22 Pa, 608 Farmers Bk Bldg, Kerr Engrd Sales Co
Salt L City Utah, 334 W 17th South, John P Reeves & Co
San Fran Cal, 420 Mrkt, Cameron Engrg Co

For additional information on products, services, and prices, use the enclosed Business Reply Cards.

Thomas C Wilson Incorporated
Long Is City 1 N Y, 2111 44th Ave, O J Bagnoli, V P ..... RA 9-3360
A John, Sales Mgr
Phila Pa, Land Title Bldg, H Steffens ..... LO 7-6943

W-K-M Division of ACF Industries Incorporated
Houston Tex, Box 2117, J S Downs, Pres ..... CA 7-8211
B R Braznell, Sales Mgr Key Prods Div
M J Conley, Sales Mgr API Gate Valves Div
Paul Nerren, Sales Mgr ASA Gate Valves Div
W A Gormley, Sales Mgr ACF Lub Plug Valves Div

Wolverine Tube, Division of Calumet & Hecla Incorporated
Allen Park Mich, 17200 Southfield Rd ..... DU 6-1000
D W Blend, VP-Genl Mgr
A R Kaspark, Sales Mgr Tech Div
J M Dumser, Sales Dir
R E Seaton, Tech Sales Supr
Chi Ill
Dallas Tex, 6138 Berkshire, John P Howland ..... EM 1-7183
Det Mich
Houston Tex
N Y NY
San Fran Cal

Worthington Corporation
Harrison N J, 421 Worthington Ave, W H Feldmann, Pres ..... HU 4-1234
A W Fraser, Sales Mgr
Albany 5 N Y, 23 Pinehurst Rd ..... AL 8-1031
Amarillo Tex, Amarillo Bldg ..... DR 2-8505
Atlanta 9 Ga, 8 Rhodes Center N NW ..... TR 2-1106
Balt 2 Md, 210 E Saratoga St ..... LE 9-3210
Beaumont Tex, 2360 Calder Ave 4-2212
Birm 3 Ala, 10 Office Pk Circle ..... TR 1-5163
Boston 14 Mass, 150 Causeway St Rm 609 ..... CA 7-3323
Buff 2 N Y, 43 Court St MA-5150
Charleston 1 W Va, 714½ Lee St ..... DI 6-0172
Charlotte 2 N C, 123 N Poplar St ..... ED 4-5134
Chi 6 Ill 400 W Mad St ..... FR 2-1628
Cinn 2 O, 812 Race St ..... PA 1-5733
Cleve 15 O, 3111 Carnegie Ave ..... ED 1-6600
Corpus Christi Tex, 406 Oil Ind Bldg ..... TU 3-9451
Dallas 2 Tex, 1826 Life of Amer Bldg ..... RI 1-4155
Denver 2 Colo, 1640 Blake St ..... TA 5-7284
Det 27 Mich, 13305 Puritan Ave ..... BR 3-5990
El Paso Tex, 303 N Oregon St ..... KE 3-0921
Ft Worth Tex, 712 Ft Worth Bk Bldg ..... ED 6-2016
Grd Rpds Mich, 314 Rosewood Ave SE ..... GL 6-9439
Greenville S C, 501 E North St 5-5275
Houston 24 Tex, 3484 W 12th St ..... CA 8-1441
Indpls 2 Ind, 1333 N Penna St ..... ME 4-3268
K C 8 Mo, 1608 Balt Ave ..... BA 1-9636
Knoxville 2 Tenn, 208 Daylight Bldg 3-0071
L A 58 Cal, 5075 Santa Fe Ave ..... LU 3-6451
Louisville 2 Ky, 305 W Bwy ..... JU 7-1762
Milw 2 Wis, 312 E Wis Ave ..... BR 6-5518
Mpls 4 Minn, 907 13th Ave S ..... FE 5-1192
N O 7 La, 308 Whitney Bldg CA-8382
N Y 16 N Y, 99 Park Ave ..... OX 7-2345
Newark N J, 401 Wash Ave (Harrison) ..... HU 4-1234
Omaha 2 Neb, 1115 Woodmen of the World Bldg AT-1250
Phila 32 Pa, 2905 N Broad St ..... BA 3-9900
Pgh 19 Pa, 2821 Koppers Bldg ..... AT 1-4266
Port 14 Ore, 1815 SE 7th Ave ..... BE 2-1158
Roch 4 N Y, 1150 Sibley Tower Bldg ..... HA 6-6187
St Louis 3 Mo, 3505 Lindell Blvd ..... JE 3-2177
Salt L City 11 Utah, 118 Social Hall Ave ..... EM 4-6591
San Antonio 9 Tex, 6936 San Pedro Ave ..... TA 6-2816
San Fran 7 Cal, 224 Townsend St ..... GA 1-4906
Seattle 1 Wash, 2616 Western Ave MA-4218
Shreve La, 302 Sklar Bldg 5-5015
Springfield 3 Mass, 496 Bridge St ..... RE 3-2113
Syracuse 2 N Y, 624 State Tower Bldg ..... HA 2-3870
Toledo O, Box 48 (Oak Harbor) OH-5865
Tulsa 6 Okla, 175 N Lansing ..... LU 5-5581
Wash 5 D C, 1140 Woodward Bldg ..... ST 3-8822
Wilm 1 Del, 1720 Penna Ave ..... OL 8-7172

Wright Hoist Division, American Chain and Cable Company Inc
York Pa

Wyandotte Chemicals Corporation, Division of Michigan Alkali
Wyandotte Mich, Biddle at Clark St ..... AV 2-3300
Bert Cremers, Vice Pres and Genl Mgr
S B Scott, Genl Sales Mgr Mich Alkali Div
C F Gerlach, Sales Mgr Inorganic Chem-Mich Alkali Div
W L Rippeteau, Sales Mgr Organic Chem-Mich Alkali Div
Atlanta 5 Ga, 3230 Peachtree Rd NE, Roger W Moister ..... CE 7-9784
Baton Rouge La, 304 La Natl Bk Bldg, Scott Starkey ..... DI 4-0328
Chi 11 Ill, 435 N Mich Ave, H C Brunner ..... SU 7-8866
Pasadena Cal, 232 N Lake St, Jack M Norcott ..... SY 2-5126
N Y 17 N Y, 60 E 42nd St, M A Thompson ..... MU 2-1780
Wyandotte Mich, 1609 Biddle, Martin J Conway ..... AV 2-3300

Wyatt Metal and Boiler Works Incorporated
Houston 1 Tex, 6200 Kansas St, W B Van Wart, Pres ..... UN 1-6141
Jack C Roberts, Asst Sales Mgr
Dallas 22 Tex, 1618 W Commerce, Jack C Roberts ..... RI 7-8741
L A 48 Cal, 6505 Wilshire Blvd, G Russell Nance ..... OL 3-0360
Moorestown N J (Phila) Box 187, A B Seither ..... BE 5-2340
N Y 17 N Y, 7 E 42nd St, J F Bechtle ..... MU 7-6465
Pgh 19 Pa, 530 Sixth Ave, L T Willhelm ..... GR 1-6284
Tulsa 3 Okla, 310 Thompson Bldg, H M Rosevear ..... DA 3-7047

X

X-Ray Engineering International, Division of Atomic Supply Corp
San Fran 11 Cal, 420 Mrkt St, W W Offner, Pres ..... YU 2-5678

Y

Yarnall-Waring Company
Phila 18 Pa, Chestnut Hill, D Robert Yarnall, Pres ..... CH 7-3117
J Kildare, VP-Sales
J A Steer, Sales Mgr Boiler Trim Div
R S Pollard, Sales Mgr Steam Trap Sales

Otto H York Company Inc
West Orange N J, 6 Central Ave, Otto H York, Pres ..... OR 7-3000
E W Poppelle, Sales Mgr
York Process Equipment Corp, Eric H Beckhusen, Sales Mgr ..... OR 7-3000
York Separators Inc, John L Reid, Sales Mgr ..... OR 7-3000

Young Radiator Company
Racine Wis, 709 S Marquette St, F M Young, Pres ..... ME 2-4441
W G Schlichting, Sales Mgr Heating & Air Cond
A L Kreul, Sales Mgr Contract Prods Div
D W Retzinger, Sales Mgr Heat Exch Div
A D Bogus, Sales Mgr Ind & Oil Field Div

Youngstown Sheet and Tube Company
Youngstown 1 O, Stambaugh Bldg, M H Watkins, V P ..... RI 7-0771
J M Tuthill, Genl Mgr of Sales

Yuba Consolidated Industries Incorporated
San Fran 4 Cal, 351 Cal St, J L McGara, Pres ..... EX 2-0274
L J Van Orden, Sales Mgr Adsco Div
John B Link, Sales Mgr Calsteel Div
Robt A Beck, Sales Mgr Yuba Heat Transfer Div
Chi 6 Ill, 205 W Wacker Dr, Robt Haack ..... RA 6-6961
Cleve 11 O, 12703 Triskett Rd, W J Daugherty ..... CL 2-1030
N Y 36 N Y, 530 Fifth Ave, Robt Shaw ..... OX 7-9140
Phila 7 Pa, 1714 Phila Natl Bk Bldg, E R Averett ..... RI 6-3420
Pgh 22 Pa, 1429 Oliver Bldg, M J Hannah ..... GR 1-7697

Z

Zallea Brothers
Wilmington Del, Taylor & Locust Sts, Sol Zallea, Pres ..... OL 4-2407
Harry Wolpert, Sales Mgr

John Zink Company
Tulsa Okla, 4401 S Peoria, John S Zink, Pres ..... RI 7-1371

SUPPLEMENTAL COMPANY, PRODUCT, AND SERVICES LISTINGS

A O Smith Corporation, Meter Service Station Pump Division
L A 22 Cal, 5715 Southway St, Harry G Smith, Pres ..... RA 3-3361
H D Leisenring, Sales Mgr Meter Serv Sta Pump Div
Atlanta Ga, 440 Northside Dr NW, T C Ficken
Chi 4 Ill, 310 S Mich Ave, J F McDonald
Houston 2 Tex, 240 Mellie Esperson Bldg, J W Harris
N Y 17 N Y, 250 Park Ave, H D Leisenring
Positive Displacement Flow Meters

Solvay Process Division, Allied Chemical and Dye Corporation
N Y 6 N Y, 61 Bwy, I H Munro, Pres ..... HA 2-7300
A Phillips, Dir of Sales
Boston 9 Mass, 45 Milk St, M S Johnson ..... HA 6-2160
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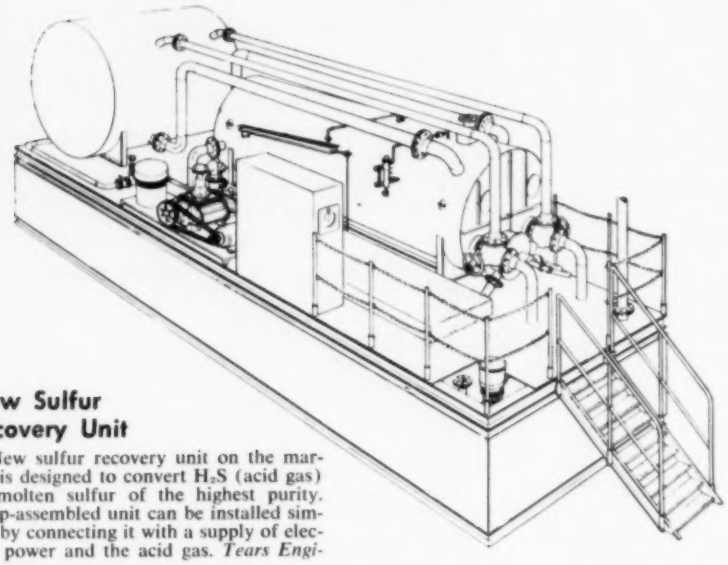
Valves — Angle, Check, Gate, and Globe, Screwed and Flanged Fittings, Unions

✔ *Advertisement in this issue, index is on page A-6.*

NEW Refining Equipment

• machinery • supplies • services

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers



New Sulfur Recovery Unit

New sulfur recovery unit on the market is designed to convert H_2S (acid gas) to molten sulfur of the highest purity. Shop-assembled unit can be installed simply by connecting it with a supply of electric power and the acid gas. *Tears Engineers.*

Circle number (41) on reply card.

New Petroleum Inhibitor

Development and availability of new, multi-purpose dispersant inhibitor for petroleum products has been announced. POLYFLO 100, the new dispersant has also proved potent in minimizing deposits and stabilizing color in diesel oils, distillate burner oils, and residual fuels. *Universal Oil Products.*

Circle number (42) on reply card.

New Asbestos-Base Block Insulation

Abosite combining durability, lightness of weight, minimum shrinkage and other desirable features has been introduced. It is available in 2 types to withstand temperatures to 1000 and 1850 F. These types are labeled Standard and Super. *The Aber Company.*

Circle number (43) on reply card.

EWC Condulets

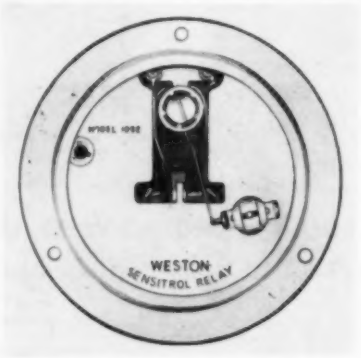
New EWC series condulets of threaded joint construction that can be used indoors or out has been introduced. Explo-

sion and dust ignition proof, weather resistant and rain tight, condulet series features aluminum cover with feraloy housing. *Crouse-Hinds Company.*

Circle number (44) on reply card.

Adjustable Sensitive Relay

All-purpose, fully adjustable sensitive relay is being introduced. Relay's wide range of adjustments permits number of



accurately repeatable settings by turning 1 adjusting screw. *Weston Instruments Division, Daystrom, Inc.*

Circle number (45) on reply card.

Valves Incorporate Line of Static Seals

Valves are designed to handle extreme temperatures involving fuels, oils, gases and other fluids and liquids. The Skinner static spring seal is an integral part of a Skinner poppet valve for effective internal sealing while externally the sealing is successfully accomplished with individual Skinner static spring seals — used between the body and the end-piece of the valve. *Skinner Seal Company.*

Circle number (46) on reply card.

Nucleonic Announced Density Measurement System

AccuRay Density System which measures and/or controls fluid density, specific gravity, percent solids, or related quantity has been announced. Based on principle of gamma-ray transmission from a radioisotope, system makes no physical contact with the flowing material.

Depending upon the process and material measured, long term accuracies of ±.001 to ±.003 specific gravity are readily obtainable. The system can be furnished with sensitivities to the order of 0.0001 specific gravity. *Industrial Nucleonics Corporation.*

Circle number (47) on reply card.

Ratio & Multiplying Pneumatic Relays

Ratio and multiplying pneumatic relays for producing an output according to input have been added to utility and proc-

ess instruments. New instruments have pneumatic component that incorporates null-balance-vector principle for accuracy and sensitivity. *Republic Flow Meters Company.*

Circle number (48) on reply card.

Thermal Conductivity Gas Analyzer

Industrial thermal conductivity gas analyzer for continuous monitoring of 1 constituent in combination gases is announced. Instrument, designated the Model 7C, is designed for use in measuring such gases as nitrogen, hydrogen, argon, and carbon dioxide in power generating, ammonia, petroleum refining, etc. *Beckman Process Instruments Division.*

Circle number (49) on reply card.

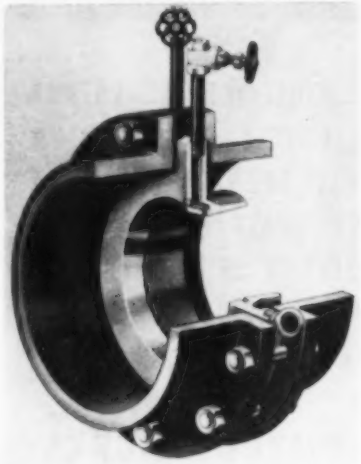
Shock Absorbers

Hydraulic shock absorbers are proving to be a solution to problems of pipeline vibration in oil refineries. Locating shock absorbers at "danger points" in lines, damaging vibration can be eliminated. *Buffalo Hydraulics Division, Houdaille Industries, Inc.*

Circle number (50) on reply card.

New Orifice

The Dall orifice is intermediate both in pressure loss and in cost between the square-edged orifice plate and the Dall tube. It is particularly suitable for use where pressure recovery is of importance



but space or first cost precludes the use of a Dall tube. The pressure loss with a Dall orifice would be only 19 in. w.g., compared with 60 in. w.g. for an ordinary orifice plate or a flow nozzle. *George Kent Ltd.*

Circle number (51) on reply card.

Heating and Steam Boiler

Designated the Hercules "Thermodyne," the company terms the new quick heat unit the first breakthrough in boiler design in decades and the most powerful and economical unit for its size ever built. Test units already in service have reduced fuel operating costs by a third and maintenance upkeep by 50 percent. *Hercules Power Equipment Company.*

Circle number (52) on reply card.

Sprayed Ceramics

Sprayed ceramic service for coating parts and equipment with chemically inert ceramic coatings is now available. Highly resistant to corrosion, abrasion and erosion coatings can be applied in any thickness. *Chemical & Power Products, Inc.*

Circle number (53) on reply card.

Forged Steel Valve

Featuring the preferred bolted bonnet design, with outside-screw rising stem, solid-wedge disc, and rolled-in seat rings, these gate valves are available with screwed or socket welding ends in sizes ½ in. through 2 in. These valves are rated 800 lb at 850 F, and 2000 lb at 100 F. *The Lunkenheimer Company.*

Circle number (54) on reply card.

Thermal Conductivity Cell

The CDC-1 thermal conductivity cell, specifically designed for vapor phase chromatography, employs thermistors as sensory elements. Available in two sensitivity ranges, the cell can be incorporated into existing chromatographic apparatus or used as a component for new equipment. The unit operates to 240 C. *Largent Company.*

Circle number (55) on reply card.

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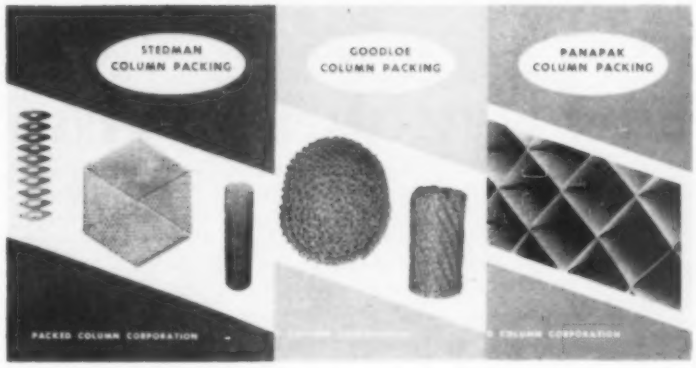

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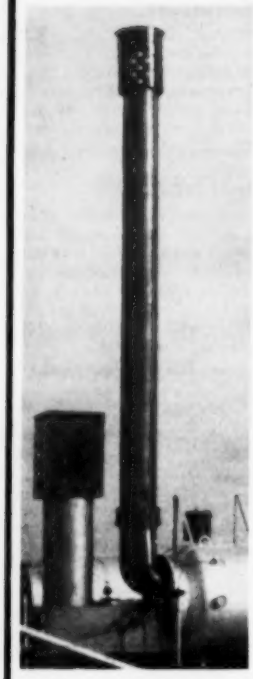
on your heating units — AND —



A Moran Positive Draft Control installation.

- INCREASE DELIVERABLE OUTPUT
- DECREASE FUEL CONSUMPTION
- DECREASE OPERATIONAL COST
- DECREASE MAINTENANCE COST
- INCREASE LIFE OF HEATING UNIT
- DECREASE STACK TEMPERATURE
- INCREASE STACK LIFE

HOW "MPDC" WORKS

MORAN POSITIVE DRAFT CONTROL is a system for controlling the combustion air entering and leaving the heating unit. All combustion air *must* pass through a Moran Draft Equalizing Stack Head and capacity chamber before entering the intake of the heating unit. This Stack Head eliminates the effect of wind at the intake of the heater. After combustion takes place, all combustion gases *must* leave the heater through the heater stack, which is also equipped with a Moran Draft Equalizing Stack Head. This Stack Head eliminates the effect of wind at the top of the stack. This combination of two Moran Draft Equalizing Stack Heads, and a capacity chamber, is MORAN POSITIVE DRAFT CONTROL.

WHY "MPDC" SAVES YOU MONEY!

- - - because with its installation you automatically eliminate all excess air not needed for combustion. *Excess air is very expensive.* Excess air not needed for combustion acts as a cooling agent, which *reduces* the *unit's deliverable output.* This reduced output necessitates the use of *additional fuel* to heat the excess air in order to reestablish the output desired.

The presence of excess air usually shows itself in the form of — increased fuel cost — operational fluctuations — the inability to carry peak load in high winds — and increased maintenance of equipment. When you eliminate excess air you remove the chief source of most heater inefficiencies.

WHY THROW MONEY TO THE WIND? — GIVE YOUR HEATING UNITS A CHANCE TO PERFORM EFFICIENTLY. INSTALL MORAN POSITIVE DRAFT CONTROL — NOW!

MORAN "Peerless" Weatherproof Meter Houses • MORAN Safety Heaters • MORAN Exhaust Air Jackets • MORAN Safety Equipment • See Directory Section for complete MORAN line.

MORAN

FURNACE AND SHEET METAL COMPANY 807 E. 5TH PL. TULSA 20, OKLA.

New Equipment

Channeled-Clad Plate with Built-In "Coils"

The heavy base plate (generally of steel) is channeled before the alloy or nonferrous cladding layer is applied to form coil-like passageways for a cooling or heating medium in the very heart of the finished clad plate—and at a selected distance from either surface. The new plate with its integral internal coring is aptly named Channeled Hortonclad. *Chicago Bridge & Iron.*

Circle number (56) on reply card.

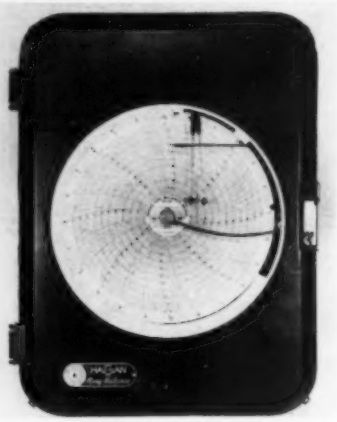
New Epoxy Silicone Chemical

New organic functional silicone chemical has been introduced. Resins, dyes, waxes, oils, plasticizers, light stabilizers, heat stabilizers, pharmaceuticals, and fungicides may find use for this chemical. *Dow Corning Corporation.*

Circle number (57) on reply card.

New Electronic Recorder

The instrument can be used to record any quantity measured by a Hagan ring balance meter, including fluid density, liquid level in open or closed vessels, boiler drum water levels, and temperature and pressure compensated fluid flow readings. Heart of the ring balance electronic recorder is a newly designed electronic receiver, a compact unit housing an amplifier, input box, servomotor and slide wire. As many as 4 receivers can be installed in a single recorder. *Hagan Chemicals & Controls, Inc.*



Circle number (58) on reply card.

Elimination or Reduction of Engine Stalling

In the carburetor, the chemical — dimethyl formamide, marketed to refiners as DMF Antistall Additive—works much like an antifreeze. In medium cold and humid weather, moisture in the air passing through the carburetor condenses on the throttle plate. The additive eliminates engine stalling by lowering the freezing point of the condensed moisture sufficiently to prevent any ice formation. *E. I. duPont de Nemours & Company.*

Circle number (59) on reply card.

High Vacuum Poppet Valves

New series of right angle poppet type high vacuum valves has been developed. Poppet valves have quick-acting positive air cylinders, and are suited for low-pressure applications in the micron range. *F. J. Stokes Corporation.*

Circle number (60) on reply card.

New Filtering Elements

Filtration selections are available within the following ranges: Bronze elements: 5-12, 12-25, 25-50, 50-125, or 150-200 microns; 316 stainless steel elements: 5-7, 7-10, 10-13 microns. In addition to the variety of elements, the body of the filter can be supplied with ⅛, ¼, ⅜, or ½ in. female pipe connections and is designed to permit replacement of the filtering element. *Hoke, Incorporated.*

Circle number (61) on reply card.

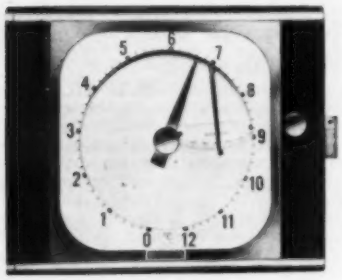
Reinforced Epoxy Pipe

Corrosion-resistant reinforced plastic pipe, strong as steel but only ⅛ the weight, is now being manufactured in 2 to 12 in. diameters to meet piping, tubing and ducting needs. The manufacturer uses a patented process employing interwoven fiber glass filaments, impregnated with epoxy resins and heat cured. The pipe comes in rigid 20-ft lengths with ends plain, bell-and-spigot or flanged. *Amercoat Corporation.*

Circle number (62) on reply card.

Dial Type Indicating Potentiometers

A new indicating version of the Dynamaster self-balancing electronic potentiometer or bridge has been announced. This instrument has the same 32-in. long scale



and the same pointer as the standard round-chart recording Dynamaster, and is mounted in a standard case. There is no recording mechanism, however, and the instrument indicates only. *The Bristol Company.*

Circle number (63) on reply card.

Low-Temperature Insulation

One of the new insulations on the market today is Armstrong Armalite, an extra light, extra efficient, foamed plastic material in broad form. Armalite was developed for cold storage rooms and low-temperature processing equipment operating at temperatures as low as 300 deg below zero. Armalite weighs only 1.25 lb a cu ft. *Armstrong Cork Company.*

Circle number (64) on reply card.

All-Plastic Solenoid Valve

Valcor announces the development of the SV-5100 series of all-plastic, corrosion-resistant solenoid valves — the only valves that have absolutely no metal contact with the fluid. Designed specifically to handle most of the corrosive media used in industry, the new SV-5100 will, in many cases, outlast its stainless steel counterpart 100 to 1. *Valcor Engineering Corporation.*

Circle number (65) on reply card.

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Whether your fabricating requirements call for a tower, a complicated stainless steel vessel, or a giant storage tank, C.S.T. can handle it.
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- **Code quality Carbon Steel**
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See our standard line of pressure vessel connections on pages 1128-1129 in the 1958 Chemical Engineering Catalog.

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NEW LITERATURE

Cooling Tower Manual

Entitled "Counterflow Cooling Tower Performance" this new manual brings together the most reliable and complete information on cooling tower selection and performance. *J. F. Pritchard & Company of California.*

Circle number (66) on reply card.

New Tamper Bulletin

A 2-color specification bulletin presents the tamper, the latest addition of specially designed attachments for Bantam's line of ⅜-yd power cranes and excavators. Along with complete specifications and job-action photos of the tamper, the bulletin also points out some of the outstanding features of the new tamper. *Schield Bantam Company.*

Circle number (67) on reply card.

Super-Alloy Tubing

Small-diameter super-alloy tubing for applications requiring strength at high temperatures is described in Bulletin 70. The materials listed as super alloys in the bulletin are those which will not rupture under a stress load of 25,000 lb per sq in. at 1200 F during a 1000-hr test period and which resist oxidation and other types of corrosion. *Superior Tube Company.*

Circle number (68) on reply card.

Tubing, Pipe and Welding Fittings

New 16-page booklet, TB-417, presents important information on the application of tubing, pipe and welding fittings. Included are application data, points to consider in selection of materials, analysis, physical, mechanical and creep strength properties of various steels and a series of case histories of cost saving applications of B&W's tubular products. *The Tubular Products division of The Babcock & Wilcox Company.*

Circle number (69) on reply card.

Flow Meter Engineering Data

The 22-page illustrated bulletin gives basic information and theory on the selection, sizing and installation of the various types of differential pressure flow meters. After an introductory section outlining the theory of head type flow rate meters, the basic primary devices, their uses and characteristics are described. *The Bristol Company.*

Circle number (70) on reply card.

Fuel Oil Blending Data Given

Technical data on blending fuel oils is contained in an 8-page bulletin issued. Economics of 2-component fuel oil blending are discussed and problems solved, through use of full-page nomographs contained in bulletin. *Proportioneers, Inc.*

Circle number (71) on reply card.

LQ600 Valve Reports

These reports detail the problems, solutions, and results experienced by well-known manufacturers in almost all industries, through the installation of Lunkenheimer LQ600 valves. Illustrations of each valve application are included. *Lunkenheimer Company.*

Circle number (72) on reply card.

New Literature

Petrochemical Product File

A new 4-page product specifications folder on petrochemicals is available. Included in the folder are specification sheets on the company's high purity, nitration grade benzene and toluene, 5 deg xylene, high aromatic solvents and mineral spirits. *Chemical Division, Delhi-Taylor Oil Corporation.*

Circle number (73) on reply card.

Maximum Product Recovery in the Natural Gasoline Plant

A new application data sheet gives detailed information on the use of gas chromatography for continuous analysis of all important gas streams within the natural gasoline plant for optimum output. *Beckman/Process Instruments Division.*

Circle number (74) on reply card.

M-S-A Combustible Gas Analyzer

Model "F" is presented in a new 8-page bulletin. The bulletin describes flexible new instrumentation for centralized process control and industrial safety, including remote equipment that can be used at high temperatures and featuring sensing filaments of exceptionally long life. *Mine Safety Appliances Company.*

Circle number (75) on reply card.

Pyrometer Supplies Buyers' Guide

Catalog G100-8 describes Honeywell's complete line of Thermocouple accessories for measuring temperature. This issue includes Meg-O-PaK assemblies and new insulated extension wire. *Minneapolis-Honeywell Regulator Company.*

Circle number (76) on reply card.

Piston Ring Replacement

Eight-page brochure designed to help obtain maximum engine performance by replacement of piston rings has been published. Procedures for checking pistons and cylinders are included as well as suggestions on the installation of new rings. *Koppers Co., Inc.*

Circle number (77) on reply card.

Ductile Iron Digest

Eighteen pages describe new metal as strong as carbon steel — tensile strength up to 200,000 psi. It can literally be twisted and bent without cracking — has as much as 30 percent elongation. *The International Nickel Company, Inc.*

Circle number (78) on reply card.

REPRINTS AVAILABLE

How to Design Multicomponent Fractionators and How to Design an Effective, Low-Cost Tank Mixing Device

These are reprinted from December 1957 issue of *The Refining Engineer*. For the Multicomponent Fractionators' reprint send 50¢ in coin for single copy (additional copies 25¢ each). For the Low-Cost Tank Mixing Device reprint send 25¢ in coin for single copy. These orders should be directed to:

The Refining Engineer
Reader Service Department
Box 1589
Dallas 21, Texas

NELSON STARTERS
engineered for easier installation

Pictured above is an installation of NELSON Class 420 explosion-proof combination starters in the MARLEX* 50 Polyethylene Semi-Works Plant at the Phillips Chemical Company Research Center.

Nelson explosion-proof combination starters are shipped completely assembled, ready for installation, eliminating expensive field wiring. By removing four screws, all pan-mounted equipment can be removed leaving the entire enclosure clear for wire and cable pulling where desired. These features are a major factor in the growing demand for Nelson explosion-proof equipment.

These starters provide a convenient way to supply both automatic protection and control in Class 1, Group D, hazardous locations such as those found in refineries, petro-chemical plants, etc. More and more companies are recognizing the leadership of Nelson in manufacturing explosion-proof enclosures, and are specifying Nelson Starters when safety is of utmost importance.

For more information on Nelson Combination Motor Starters, write for Bulletins 420 and 1026.

**MARLEX is a trademark for Phillips family of olefin polymers.*

a major source of electrical control equipment for industry

NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA

New Equipment

Serrations Replace Smooth Faces

Tube Turns announces replacement of its existing line of smooth-face flanges with a complete line of flanges with concentric-serrated faces for polyvinyl chloride piping systems. By adopting concentric serrations instead of the phonograph record type of spiral serrations, it eliminates the chance of a fluid traveling around the spiral grooves between serrations until it eventually leaks from the flange. With concentric serrations the fluid is sealed off at the first serration. *Tube Turns Plastics, Inc.*

Circle number (79) on reply card.

Vibrationless Magnatrol Valve

Excellent results can be obtained with the new Magnatrol hum-free solenoid valves in the automatic remote control of liquids and gases used in space heating systems. These type T full port valves will handle steam, liquids and gases not injurious to bronze, and at temperatures up to 400 F. *Magnatrol Valve Corporation.*

Circle number (80) on reply card.

Process Equipment Made By New Technique

Recent developments have provided etchants and milling techniques to mill many of the metals commonly used in process equipment, such as carbon steels, stainless steels, Inconels, Monels, nickel steels and many others. The chemical milling technique makes it possible to remove metal, to close tolerances from these hard alloys as easily as it is removed from soft aluminum parts. *United States Chemical Milling Corporation.*

Circle number (27) on reply card.

Hygrothermograph

Hygrometer accuracy, carefully calibrated against laboratory standards, is guaranteed repeatable within ±3 percent relative humidity. Operating range is 15 percent to 95 percent R. H. at temperatures from 32 F to 130 F. Accuracy of the hygrometer is derived from the use of a specially designed animal membrane diaphragm. *Serdex, Inc.*

Circle number (28) on reply card.

New Valve Line

A 2-way solenoid valve that combines large orifice capacity with high pressure differential is announced. A normally open or normally closed valve with ¼-in. orifice and ¼-in. NPT and the ability to handle pressure from 5 to 200 psi is now offered. *Skinner Electric Valve Division.*

Circle number (29) on reply card.

Super-Alloy Tubing

Comprising 16 different analyses, the super-alloy tubing is limited to heat-resistant alloys which will not rupture under a stress load of 25,000 lb per sq in. at 1200 F during a 1000-hr test period. At the same time they resist oxidation and other types of corrosion. *Superior Tube Company.*

Circle number (30) on reply card.

New Literature

Brochure Describes Field Construction Department

New brochure describes field construction department of the Nooter Corporation, fabricators and erectors of processing equipment. Reader is taken on a conducted field tour, to show some field construction jobs. *Nooter Corporation.*

Circle number (31) on reply card.

Process Equipment for Chemicals

Processing equipment for chemicals and by-product recovery, is subject covered in bulletin recently published. Bulletin gives mechanical descriptions and specifications of equipment and special equipment for unusual processes. *Buflovak Equipment Division, Blaw-Knox Co.*

Circle number (32) on reply card.

pH Systems on Cooling Towers

Data sheet describing use of industrial pH systems on water cooling towers is available. With pH control and adjustment time of less than 15 sec, acid is fed into the pump suction pit following activation. *Beckman/Process Instruments Division.*

Circle number (33) on reply card.

Globe Valve

Circular 608 details the Lunkenheimer Fig. 405 Bronze "N-M-D" Globe Valve, with renewable Teflon disc and packing, designed to meet critical requirements for handling oxygen, nitrous oxide, and other gases. Rated at 400 lb WOG, it controls gaseous oxygen at temperatures of minus 50 F to 150 F. *Lunkenheimer Company.*

Circle number (34) on reply card.

Indicating Recording Controlling Thermometers

Catalog C60-2 describes the complete line of Brown rectangular case filled system thermometers. These indicators, recorders, transmitters, and electric or pneumatic control instruments are covered in detail in the new 56-page catalog. *Minneapolis-Honeywell Regulator Company.*

Circle number (35) on reply card.

Tube Forgings

A booklet has been prepared to serve as a condensed clarification of the major points of customer and prospect inquiry regarding precision welding fittings and flanges. It covers subjects such as quality of tubing, product certification, heat code identification, quality inspection, terms and conditions, distribution and the Tube Forgings pledge and warranty. *Tube Forgings of America, Inc.*

Circle number (36) on reply card.

Welding Fittings and Flanges

New 4-page folder, known as Bulletin FB-503, explains the proper ways to prepare the requisition or order for welding fittings and flanges. By following the suggestions in this folder, the buyer can be sure that the supplier will understand what he requires. *The Tubular Products division of The Babcock & Wilcox Company.*

Circle number (37) on reply card.

Glassed Centrifugal Pump

A 16-page "Facts" booklet on the glassed centrifugal pump has been issued. Included is a brief history of the development of this revolutionary pump and authoritative answers to over 30 of the most frequently asked questions about the pump by chemical and process engineers. *Goulds Pumps, Inc.*

Circle number (38) on reply card.

Iso-Kel Process

An illustrated brochure describes the new isomerization process designed to help refiners increase their high octane pool by upgrading combined streams of pentane and hexane fractions as well as natural gasoline. The brochure tells how M. W. Kellogg developed the process. *The M. W. Kellogg Company.*

Circle number (39) on reply card.

Seamless Mechanical Tubing Tolerances

Technical data card, TDC-115D, covers, in detail, the important dimensional tolerances, both cold-drawn and hot-finished, of round, seamless carbon and alloy steel mechanical tubing in various conditions of heat treatment. *The Tubular Products division of The Babcock & Wilcox Company.*

Circle number (40) on reply card.

Infrared Analysis of Sulfur Dioxide

New data sheet gives detailed information on 3 important areas of sulfur dioxide analysis; sulfur recovery from petroleum sour gas, controlling reaction velocity in the sulfuric acid plant, and monitoring stack gas in power plants for air pollution regulation. *Beckman/Process Instruments Division.*

Circle number (106) on reply card.

Nutating Disc Meters

A two-page bulletin (OG-414) describing Rockwell "961" nutating disc meters designed to measure lubricating oils, kerosine, diesel fuel and gasoline has been issued. Two models, 1 open and 1 enclosed, available in ¾-in. and 1-in. sizes and weighing only 7-lb are shown. *Meter and Valve Division, Rockwell Manufacturing Company.*

Circle number (107) on reply card.

New Line of Fluor-Hartmann Equipment

Fluor Products now offers a complete new line of bulk pneumatic conveying, ash handling, dust control and air classifying equipment. This is possible by a recent agreement with Maschinenfabrik Hartmann A. G., Offenbach, Germany. *Fluor Products Company.*

Circle number (108) on reply card.

Model B Coupling

Brochure is available on the use of Fast's Model B couplings. Bulletin outlines principal features of line and points out that double engagement design compensates for any type of misalignment of the shafts. *Koppers Co., Inc.*

Circle number (109) on reply card.

Refining Personals

David P. Hankins, manager of Pure Oil Company's Heath, Ohio, refinery since 1955, has been appointed to the newly created position of manager of the company's Lemont, Illinois, refinery. **Dale G. Miller,** general superintendent at Heath, has been named general superintendent at Lemont, replacing **J. M. Lawson. Willard G. Dailey** is the new manager at Heath, coming there from the Toledo refinery, where he has been general superintendent. **Harry Hook** and **Jack N. West** have been promoted to the positions of general superintendent at the Heath and Toledo refineries, respectively. Both men were formerly superintendents of operations.

Loyd Thompson, Ponca City, has been promoted to chief maintenance engineer in Continental Oil Company's headquarters manufacturing department. Formerly general maintenance engineer, he will continue to make his headquarters at Ponca City and will succeed **J. O. Thoen,** who has retired.

Daniel L. Hussey has been appointed deputy manager of the new refinery now being built in Cologne, West Germany, by Esso A. G., Standard Oil Company (New Jersey) affiliate. Hussey was formerly general superintendent of Esso Standard Oil Company's Bayway, New Jersey, refinery, and more recently general manager of the Abadan refinery in Iran.

Gordon D. Kerns has been appointed senior technologist at The Vickers Petroleum Company, Inc.'s Potwin, Kansas, refinery. Previous to his current connection with Vickers Petroleum Kerns was manufacturing coordinator, Amoco Chemicals Corporation.

William H. Goryl has begun a rotational assignment as an assistant director in the design engineering division of Esso Research and Engineering Company. He had been head of the estimating services section of the firm's planning engineering division.

Dr. Alex Lewis Jr. has been promoted to manager, petrochemicals department, Gulf Oil Corporation. He previously was in charge of chemical marketing for the petrochemicals department and will succeed **L. O. Crockett** who was recently elected president of Goodrich-Gulf Chemicals, Inc. in Cleveland. Dr. Lewis' headquarters will continue to be in the Gulf Building, Pittsburgh.

Dr. Forrest W. Shaver, Akron, Ohio, has been named senior scientist, chemicals research department, at The B. F. Goodrich Research Center, Brecksville, Ohio.

William H. Rader has been made U. S. Industrial Chemical Company's assistant production manager for Petrothene Polyethylene resins. U.S.I. is a division of National Distillers and Chemical Corporation. Rader has performed customer service work, and as senior development engineer had charge of polyethylene development operations at the company's Tuscola plant.

John H. Smith has been appointed to the newly-created post of chief design coordinator in Sun Oil Company's manufacturing engineering division. Formerly project engineer, Smith assumes general supervision of the division's design section. **Fulton K. Niece** is named as project engineer succeeding Smith, and **H. George Shimp** as process engineer. Niece was previously assistant project engineer and Shimp was assistant process engineer.

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Personals

J. Gregory Harrison, assistant engineer at The Texas Company's Eagle Point refinery at Westville, New Jersey, has been promoted to engineer in the plant engineering department. He joined Texaco in June 1954. **J. R. Cutler** was named assistant superintendent of Texaco's West Tulsa refinery. Before his appointment, Cutler was assistant superintendent of light oil processing of the manufacturing department at Texaco's Port Arthur, Texas, refinery. He succeeds **J. J. Rasor,** resigned.

Henry Flynn, general superintendent of the company's refinery, at Port Arthur, has been named manager, succeeding **F. L. Wallace,** who retired. **E. W. McNealy,** assistant general superintendent since June 1957, will succeed Flynn as general superintendent. More changes of key personnel at the Port Arthur works are: **W. K. Savage** to assistant superintendent, manufacturing division — light oil processing. **R. N. Ludwig** as supervisor light oil processing, succeeding Savage. **T. H. Tepper** as assistant supervisor light oil processing, replacing Ludwig.

Edward G. Volz, St. Louis, has been appointed safety and fire protection engineer for the safety section of Monsanto Chemical Company's personnel relations department after serving as safety director of the John F. Queeny plant there. **George E. Kupchinsky,** Minersville, Pennsylvania, has become a member of the engineering department of Monsanto's inorganic chemicals division at Everett, Massachusetts. **Donald W. Rice,** Piqua, Ohio, joined the polymer section, research department, research and engineering division at Dayton, Ohio, after serving with the Leland Electric Company, Dayton, since 1953. **Henry F. Spadoni Jr.,** Hopedale, Massachusetts, became a member of the Resinox department, plastics division at Springfield, Massachusetts, after serving two years with the U.S. Army. **Richard A. Milke** named a member of the engineering department, organic chemicals division at the John F. Queeny plant, after serving for 2 years as a plant engineer with Dodge Division of Chrysler Corporation, Detroit. **Glen Olsen,** Charleston, West Virginia, became a member of the technical services department, organic chemicals division at the Nitro plant, Nitro, West Virginia. **Alan G. Eades** has become a member of the sales department, organic chemicals division at St. Louis, after three years in military service. **Walter P. Shaunessy,** named a member of the production and exploration department of Monsanto's Lion Oil Company Division at Houston, Texas, after serving with the Ohio Oil Company, Findlay, Ohio. **Donald R. Bowers** has become a member of the engineering department, inorganic chemicals division at St. Louis, after serving five months as an engineer with the Granite City Steel Company, Granite City, Illinois.

Arthur W. Brown has been named employee relations manager succeeding **Ralph L. Mason,** who retired for Standard Oil Company (New Jersey). At the same time, the company named **William H. Hadley** as manager of the insurance and social security department, the post formerly held by Brown.

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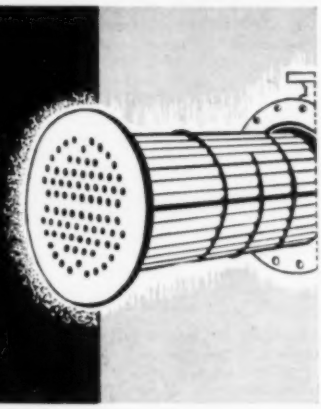

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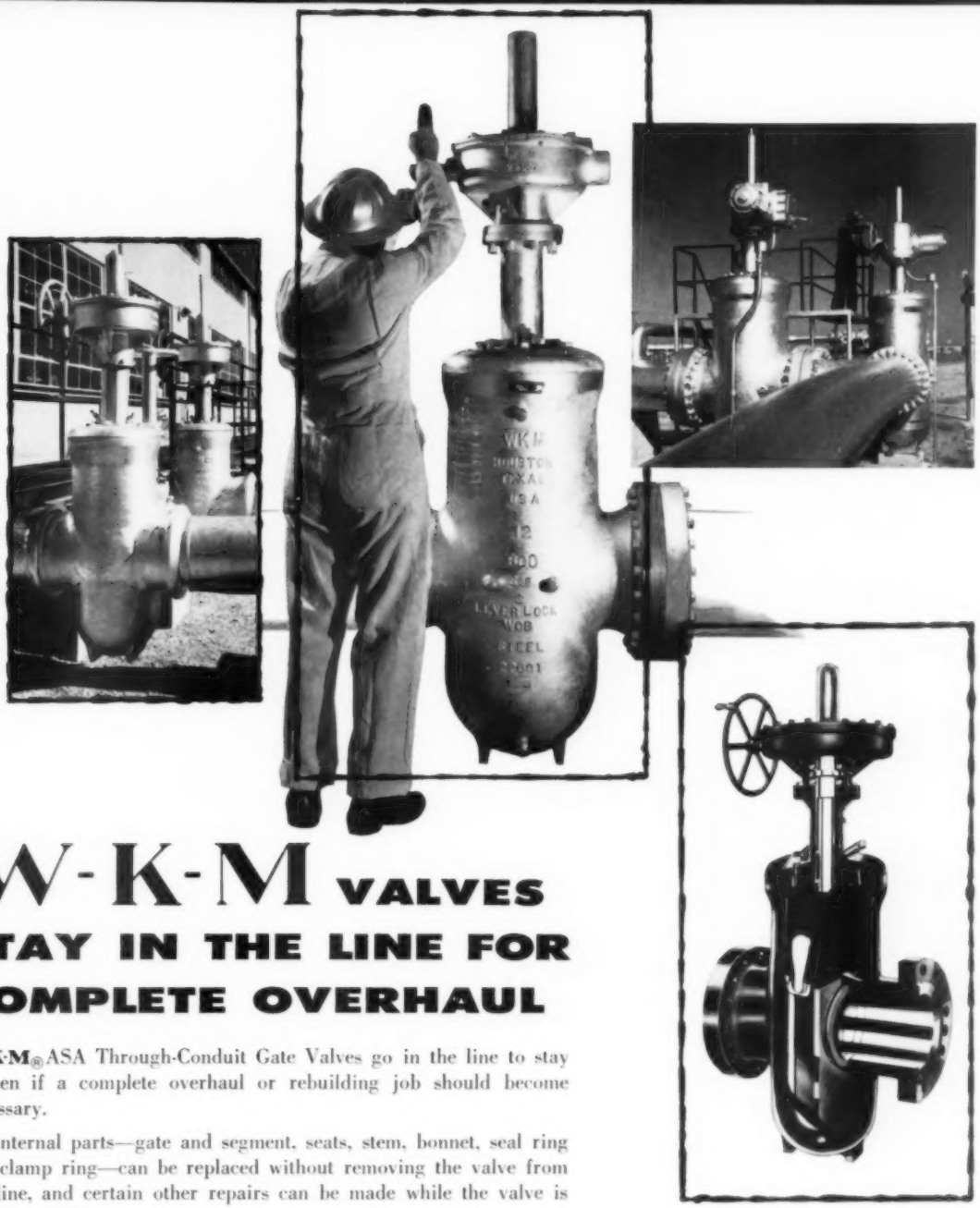

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W-K-M *ASA Through-Conduit Valves are available in sizes 2" through 30"—ASA 300 lbs. to ASA 900 lbs. Valves up to 12" are available through supply stores.*

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BUCYRUS ERIE

A Familiar Sign at Scenes of Progress

It was tough going for these 22-B hoes working on a 24-in. gas pipeline near Hawley, Pa. They excavated for a river crossing at the bottom of a gorge. Rock, quicksand, and a strong current call for machines that can do the job on schedule. Here, as on trenching jobs around the country, Bucyrus-Erie dependability pays off.

Built for rugged going, these 22-B hoes make a good showing as they trenched for the northern Ontario link of the trans-Canada pipeline. For about 78 miles through rock, mud, clay, and sand, these 22-Bs dug a 6½-ft. ditch. The line runs from the Manitoba border to Ft. William and Port Arthur, Ont. One of the men, who has operated Bucyrus-Eries since 1929, says it has been 15 years since his machine bogged down.

Bucyrus-Erie 22-Bs are fully convertible in the field from hoe to clamshell and other front ends. These clamshells cleaned out a pipeline trench and worked on a road approach in Saskatchewan, Canada. One clamshell is shown moving up as the other digs.

On both sides of the border, Bucyrus-Eries are gaining favor with pipeline contractors because of their ability to perform well under tough conditions. Here a 22-B hoe teamed up with a 22-B dragline to dig trench across the South Saskatchewan River for a 12-in. gas pipeline. The job site is near St. Louis, Sask., Canada.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

PIPELINE DEVELOPMENTS ★ ★ ★

Roundup of Planned and Proposed Construction

The following tables list the company, mileage, pipe size, and location of proposed pipeline projects — crude, products, and natural gas — reported to *The Pipeline Engineer*. Company addresses are given when known.

CRUDE LINES

Name of Company	Miles	Size	Location
Act Oils Toronto, Ontario, Canada	350		Line from Peace River area in British Columbia, thru Pine Pass to Prince George, westward to Bella Coola terminus on Pacific Coast
Afrique du Nord Development Societe	850	18	Hassi-Messaoud field, Algeria, to Mediterranean port
Alaska Yukon Pipe Lines, Inc.	254	—	Valdez to Tok Junction, Alaska
Alborz Oil Company	1000	38	Qum, Iran, to Alexandretta, Turkey
Argentine Government (YPF) Buenos Aires, Argentina	640	12	Campo Duran fields to Rosario
Atlantic-Cities-Service-Continental-Gulf-Phillips-Texas-Sinclair	Approx. 385	26	Midland, Texas, area to Houston
Bituminous Oil Pipeline, Ltd. Calgary, Alberta, Canada	250	—	McMurray to Edmonton, Canada
Bolivian Government (YPFB) La Paz, Bolivia	215	8, 10	Interior of Bolivia to Arica, Chile
Cape Pipe Line Company Philadelphia, Pennsylvania	200		Large diameter from Delaware Bay to Greater Philadelphia area refineries
Creole Petroleum Corp. Caracas, Venezuela	86	30	Temblador field to Caripito, Venezuela
Gillette Pipeline, Inc., and A. W. Hartwig, Inc.	102	—	Dead Horse Creek field to Casper, Wyoming
Great Northern Railway Co. St. Paul, Minnesota	600	12–20	Williston Basin to St. Paul-Duluth-Superior, Wisconsin-Minnesota area
Iraq Petroleum Co. London, England	Approx. 600		Kirkuk field to Iskenderun, Turkey
Jayhawk Pipe Line Corporation Wichita, Kansas	242	10, 12	Meade County, Kansas, to Valley Center
North-West Oil Pipelines Company	210		Wilhelmshaven, on the North Sea, to industrial Ruhr area of West Germany
Offshore Gathering Company Houston, Texas	364	20	Gulf of Mexico from Sabine Pass to Mississippi River
Oil Field Pipe Line, Inc. and Panhandle Eastern Pipe Line Co. Kansas City, Missouri	200	8, 12	Elkhart to Ellinwood, Kansas
Royal Dutch Shell Group and Others The Hague, Netherlands	870	30	Marseille, France, to Rotterdam, Holland, and Antwerp, Belgium
Royal Pipe Lines, Ltd. Regina, Saskatchewan, Canada	288	Var.	Cantuar area fields to Glenavon
Shell Pipe Line Corporatior Houston, Texas	100		Southwest Pass Terminal to Norco, Louisiana, Refinery
Southern Kansas Pipe Line Company	310	6, 10	Greenwood pool, near Colorado line, thru Liberal to Arkansas City, Kansas
Trans-Border Line Company	110		Skagway, Alaska, to Whitehorse, Yukon Territory
17 American, English, French and Dutch Companies	1500	38–40	Middle East producing areas to Mediterranean Coast in Turkey
Yacimientos Petroliferos Fiscales Buenos Aires, Argentina	375-434		Challaco, Neuquen Province, to Arroyo Parejas

PRODUCT LINES

Name of Company	Miles	Size	Location
American Pipe Line Co. New York, New York	1910	8–26	Beaumont, Texas, to Newark, New Jersey
Conn-Mass Pipe Line, Inc.	328	6, 8, 16	In Connecticut, Massachusetts, New Jersey
Hydrocarbons Pipelines, Ltd. Winnipeg, Manitoba, Canada	800	6–8	Edmonton, Alberta, to Fort William, Ontario
M.K.&T. and New York Central Railroads	2000	—	Houston-Kansas City-St. Louis-Indianapolis-Cleveland-Syracuse, New York, with branches to Chicago and Detroit
Mene Grande Oil Company Caracas, Venezuela	60	6	Anaco to Puerto La Cruz, Venezuela
Northwest Pipeline Corporation Salt Lake City, Utah	350	8–10	Four Corners to Salt Lake City, Utah
Service-Continental-Sinclair-Phillips	550		Salt Lake City, Utah, to Spokane, Washington
Underground Storage and Exploration, Inc.	393	6, 8, 12	Moundsville, West Virginia, to Newark, New Jersey, with laterals to Mauch Chunk, Marcus Hook, and Philadelphia

PRODUCT LINES

Name of Company	Miles	Size	Location
Union Oil Company of California Los Angeles, California	815		Shale oil plant, Rifle, Colorado, to Los Angeles area
Winnipeg & Central Gas Company Winnipeg, Manitoba, Canada	210	6	U.S. Canadian border to Winnipeg

GAS LINES

Name of Company	Miles	Size	Location
Andes Pipeline Corporation	500	12	Villamontes, Bolivia, to Antofogasta, Chile
Argentine Government (YPF) Buenos Aires, Argentina	815		Campo Duran fields to Buenos Aires
Arkansas Louisiana Gas Company Shreveport, Louisiana	300		Main and gathering lines Louisiana-Texas Gulf Coast
Coastal Transmission Corporation Dallas, Texas	574 414	22–26 Var.	McAllen, Texas, to Baton Rouge, Louisiana Gathering lines in Rio Grande Valley, Texas
Colorado Interstate Gas Company Colorado Springs Colorado	917	4–34	New lines, loops, replacements in Texas, Colorado, Nebraska, New Mexico, Kansas, Oklahoma
Cuban Gas Transmission Company (Edwin Pauley) Los Angeles, California	1000		Mexico to Florida via Cuba
Eastern Shore Natural Gas Company Salisbury, Maryland	124	6, 8	Transmission line and facilities in Delaware and Maryland
Edison Securities Company Los Angeles, California	130		San Joaquin Valley to Los Angeles
El Paso Natural Gas Company El Paso, Texas	599	6–30	New lines and loops, New Mexico and Arizona
Gulf Interstate Gas Co. Houston, Texas	352 54	30 24	Loops to lateral lines
Houston Texas Gas & Oil Company Houston, Texas	942.6	12–30	Baton Rouge, Louisiana, to Miami, Florida Laterals to serve Florida distributors and industrial users
Iron Ranges Natural Gas Co.	120 [illegible]	6, 12 12	Mesabi Iron Range to northern Minnesota North Shore of Lake Superior
Michigan Wisconsin Pipe Line Company Detroit, Michigan	[illegible]	4–24	Laterals and loops in Wisconsin, Michigan, Missouri, Illinois, Indiana
Midwestern Gas Transmission Company Houston, Texas	2047	3–24	Main line from U.S.-Canadian border near Emerson, Manitoba—Noyes, Minnesota, to Portland, Tennessee Laterals off main line to serve communities in Minnesota, North Dakota and Wisconsin
Missouri Transportation Corp. Springfield, Missouri	280	16	Delaware County, Oklahoma, to St. Louis, Missouri
Mookl Chemical & Gas Corp. Tulsa, Oklahoma	169	16	Pottawatomie County to Delaware County, Oklahoma
Natural Gas Pipeline Company of America Chicago, Illinois	416 337	36 30	Loop from Beatrice, Nebraska, to Joliet, Illinois Loop from Fritch, Texas, to Beatrice, Nebraska
Niagara Mohawk Power Corp. Syracuse, New York	196	2–16	Central, eastern, and northern New York
North Carolina Natural Gas Corp. Houston, Texas	625	2–16	Intrastate line in North Carolina
Northern Natural Gas Company Omaha, Nebraska	1355	2–30	New lines and loops, Minnesota, Wisconsin, Alberta, Texas, Oklahoma, Kansas, Nebraska, Iowa
Northern Plains Natural Gas Company (subsidiary of Northern Natural Gas Company) Omaha, Nebraska	1100	26	Alberta-Montana border to Minneapolis, Minnesota
Pacific Gas & Electric Company San Francisco, California	1300	36	Alberta, Canada, gas fields to Antioch, California
Petroleos Mexicanos Mexico City, Mexico	130	22	Reynosa to Monterrey
Piedmont Gas Co. Hickory, North Carolina	78	2–8	In Gaston, Lincoln, Catawba, Caldwell, and Burke counties, N. Carolina
Southern California Gas Co. **Southern Counties Gas Co.** Los Angeles, California	83	34	From Coles Levee to Newhall
Southern Natural Gas Company Birmingham, Alabama	371	4–20	Various lines in Louisiana and offshore
Tennessee Gas Transmission Company Houston, Texas	556 76 163 39 12 50	30 24 30 26 26 26	South of New Orleans to Portland, Tennessee Coudersport, Pennsylvania, to Hamburg, New York Loop from Portland, Tennessee, and Winchester, Kentucky, to Lancaster and Morehead, Kentucky Loop from Catlettsburg, Kentucky, to Broad Run, West Virginia Loop south of Mercer, Pennsylvania Loop from Morehead, Kentucky, to Catlettsburg, Kentucky
Texas Eastern Penn-Jersey Corporation Shreveport, Louisiana	65	30	Loop from Delmont, Pennsylvania, to Lambertville, New Jersey
Trans-Canada Pipe Lines, Ltd. Calgary, Alberta, Canada	492 48	30 24	New line from Kapuskasing, Ontario, to Sheridan, Ontario, Canada New line from Winnipeg, Manitoba, to Emerson, Manitoba, Canada
Transcontinental Gas Pipe Line Corporation Houston, Texas	375	3–36	Main line loops, laterals, extensions to system
Trans-Western Pipe Line Company Los Angeles, California	775		Four Corners area to point in California
United Gas Pipe Line Company Shreveport, Louisiana	202	30	Loops from southeast Louisiana to Mobile, Alabama

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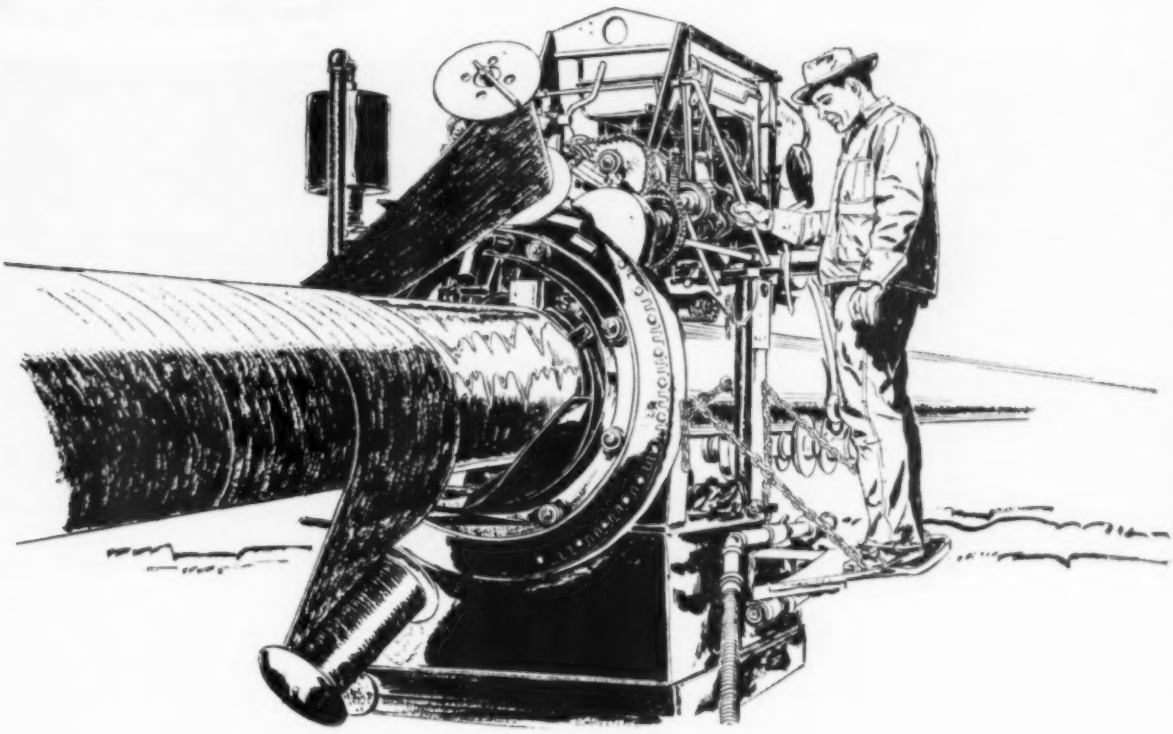

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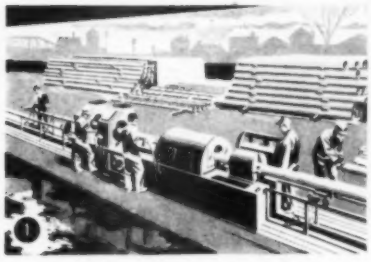

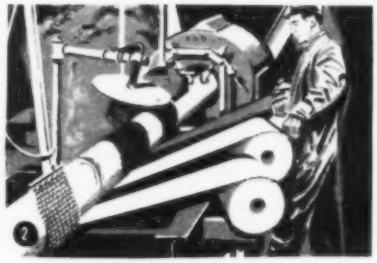

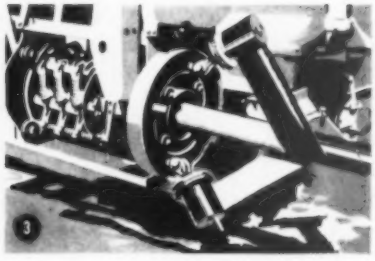

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WITHOUT BACKFILL

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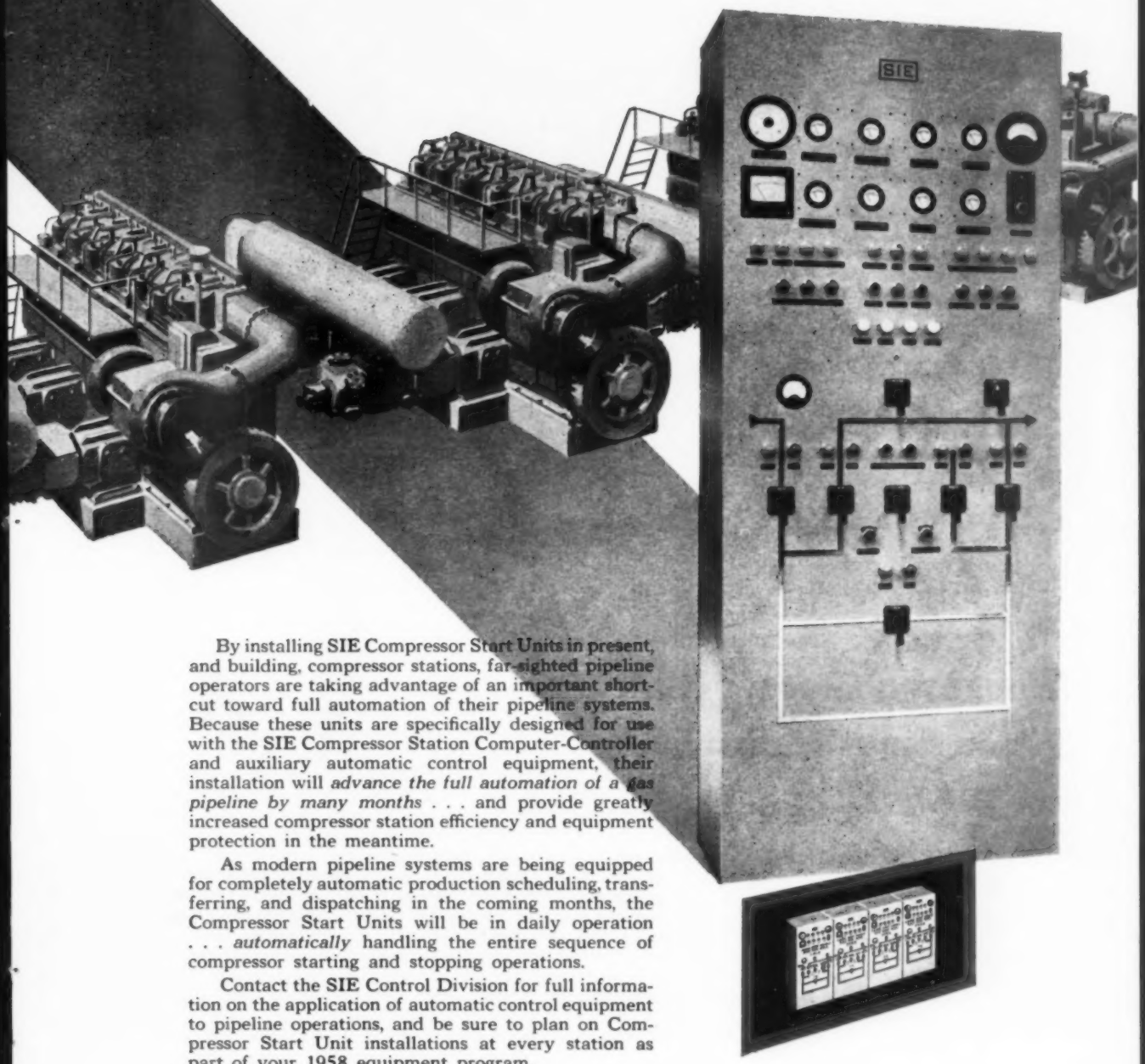
A new Dresser Industries contribution toward a *FULLY AUTOMATIC PIPELINE!*



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As modern pipeline systems are being equipped for completely automatic production scheduling, transferring, and dispatching in the coming months, the Compressor Start Units will be in daily operation . . . *automatically* handling the entire sequence of compressor starting and stopping operations.

Contact the SIE Control Division for full information on the application of automatic control equipment to pipeline operations, and be sure to plan on Compressor Start Unit installations at every station as part of your 1958 equipment program.

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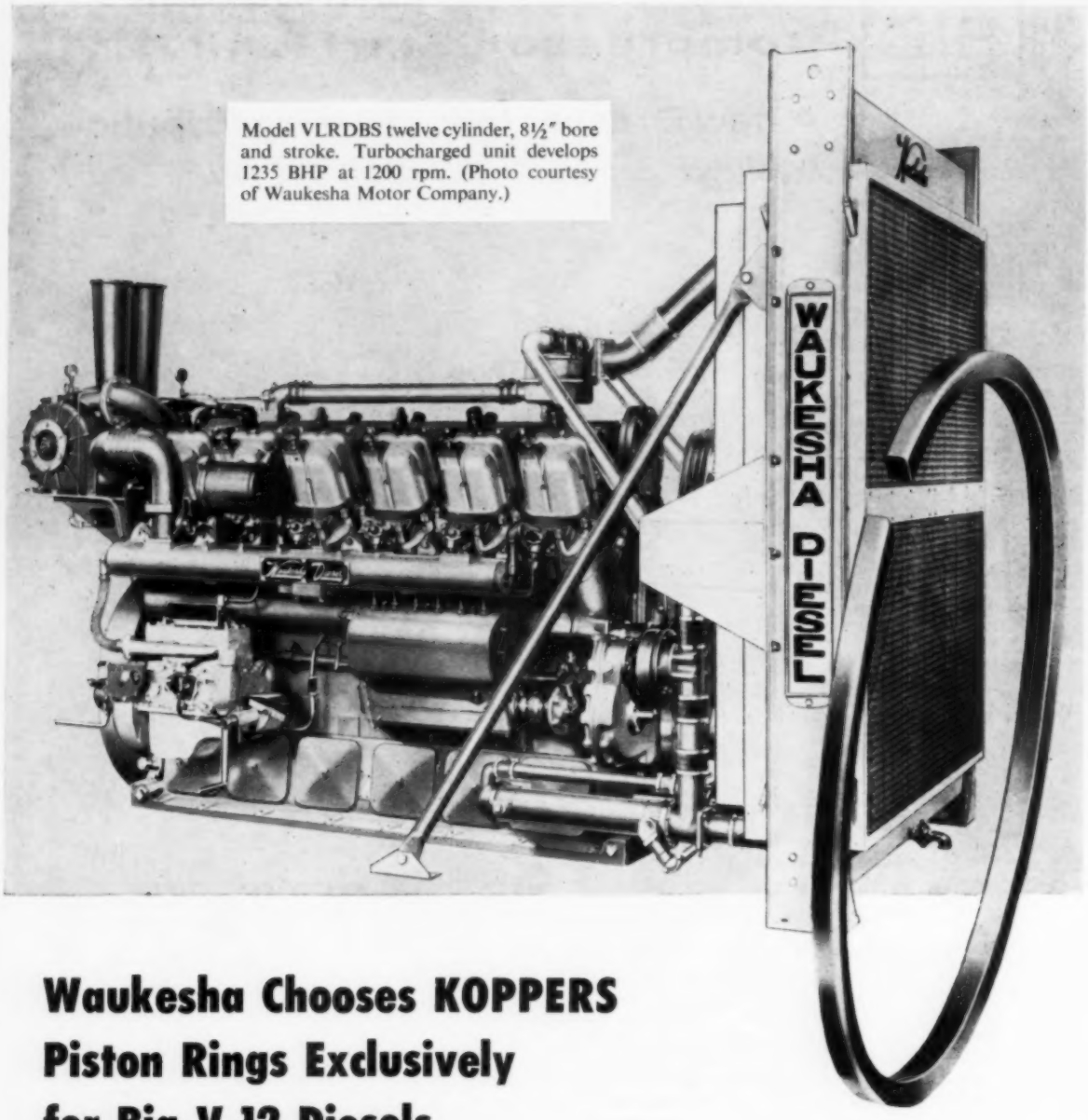

Model VLRDBS twelve cylinder, 8½" bore and stroke. Turbocharged unit develops 1235 BHP at 1200 rpm. (Photo courtesy of Waukesha Motor Company.)

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Waukesha's VLRDBS supercharged diesels are perfectly suited for applications such as oil rigs, excavators and tugboats where a surge of reserve power is essential for emergency and overload demands.

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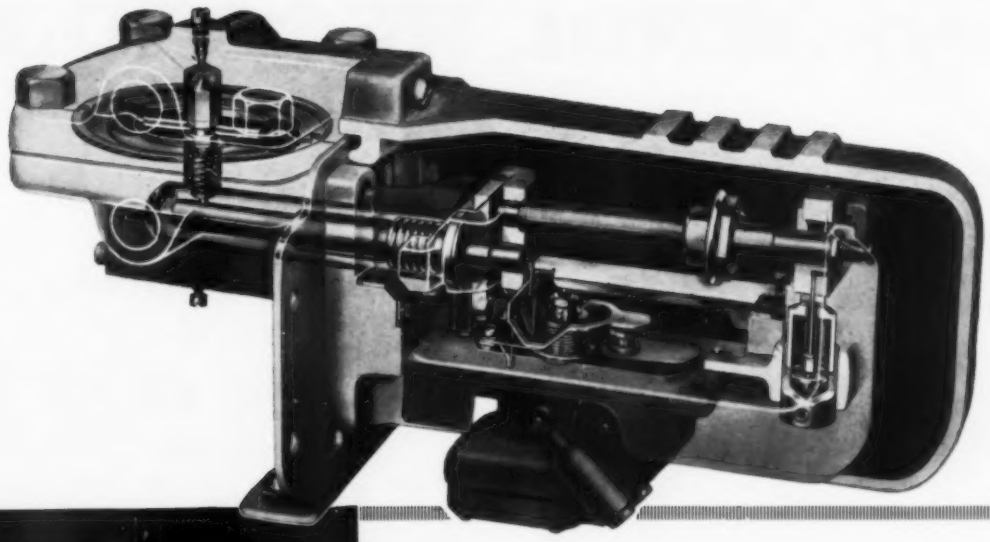

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A mercuryless remote pneumatic transmitter with a range that is continuously adjustable between 0-5 and 0-25 inches of water has just been added to the Honeywell *Differential Converter* line. Now you can choose a standard transmitter for any range from 0-5 to 0-1000 inches of water . . . a choice of ranges offered by no other manufacturer.

The *Differential Converter* measures gas and liquid flow or liquid level with accuracy within ±1% . . . and with rapid response, upscale and down. Range is continuously adjustable in the field, without parts change, and field calibration check is easily accomplished with weights. Air consumption is extremely low.

Compact and lightweight, these transmitters can be mounted anywhere. They're ideal companions for Honeywell *Tel-O-Set* miniature instruments. Call your nearby Honeywell sales engineer for details. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Phila. 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:** Write for Bulletin 2290-1, "*Differential Converter* Liquid Level Transmitter"; Catalog 2321, "Flow Meters," and Specification 248, "*Differential Converter* Flow Transmitter."

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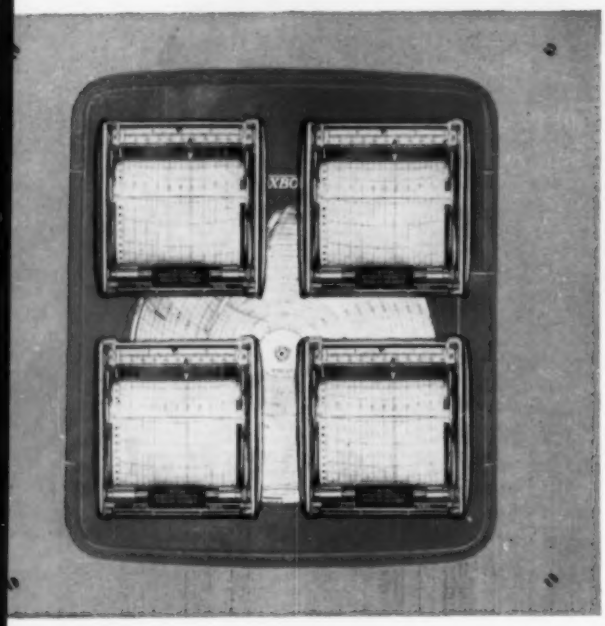
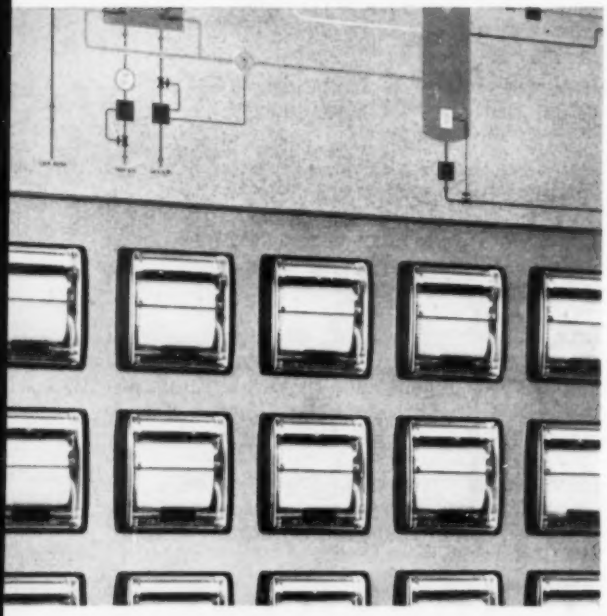


Illustration shows how 4 Consotrol Instruments require less panel space than does a single, conventional 12" recorder.



Typical control panel showing Consotrol Recording Control Stations. Associated M/58 Controllers, integrally mounted, pull out with the recorders.

The ORIGINAL small-case control panel instrument with a FULL SCALE 4 INCH CHART...

Full-scale *readability!* Here is the industry standard set by Consotrol Instruments, with no compromise in compactness, convenience, or performance.

These Recorders and Recording Control Stations are so compact you can actually mount 4 in the space required by 1 standard 12-inch recorder. And yet, inside the case, all components are full size — nothing is "miniature."

With the integrally mounted Model 58 Controller, the Foxboro Consotrol Recording Control Station provides precise, dependable control and full-scale chart records in one-quarter the panel space. Maintenance is easier too, with all calibration adjustments made from the front . . . re-inking needed only twice a year . . . chart changes as seldom as once a month.

For the complete story, write for Bulletin 13-18. **The Foxboro Company, 384 Norfolk St., Foxboro, Massachusetts, U.S.A.**

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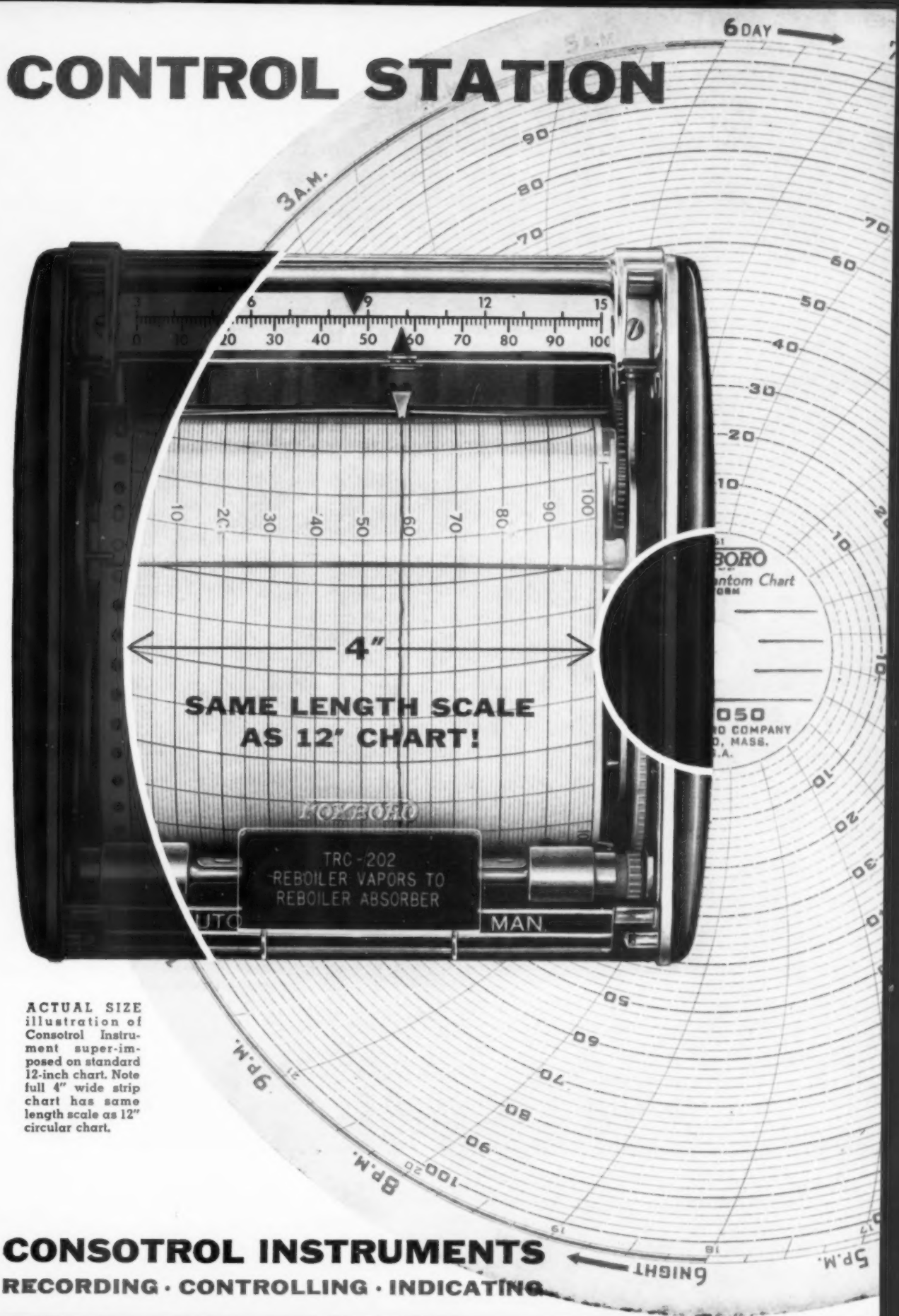
CONTROL STATION



ACTUAL SIZE illustration of Consotrol Instrument super-imposed on standard 12-inch chart. Note full 4" wide strip chart has same length scale as 12" circular chart.

CONSOTROL INSTRUMENTS

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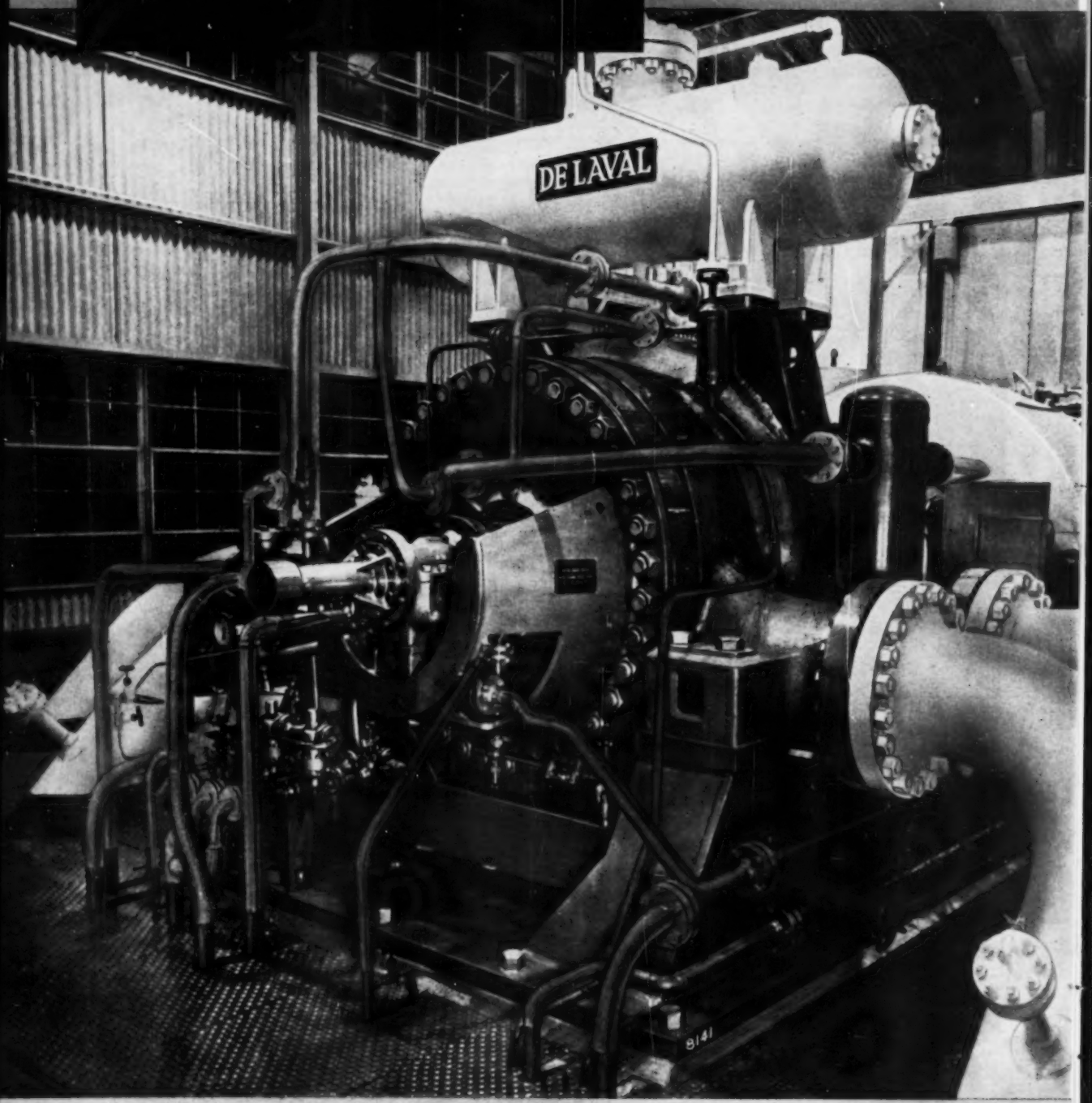
DE LAVAL
Series-Parallel
CENTRIFUGAL COMPRESSORS

provide extra



This De Laval Series-Parallel 6,350 hp centrifugal compressor is giving round-the-clock service in the Edna Station of the Trunkline Gas Company. Two other identical De Laval S-P units are doing a dependable job in the Kountze and Premont, Texas stations of this natural gas transmission system.

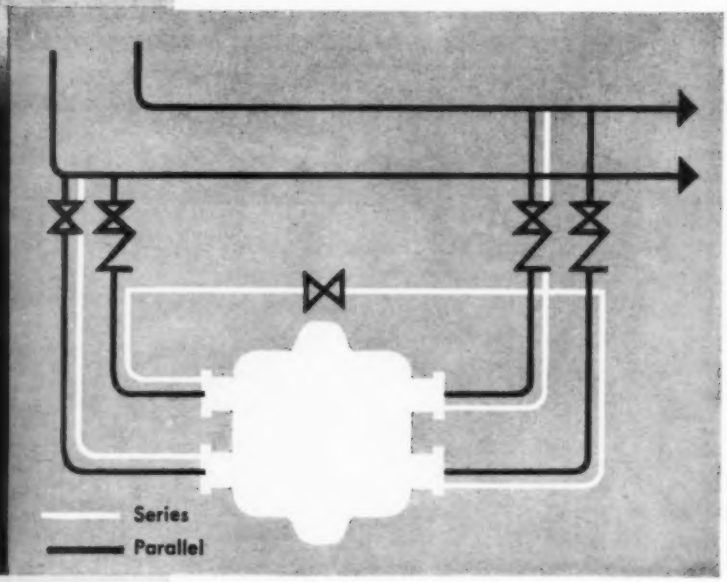
flexibility for Trunkline Gas Company

Booster station service demands flexibility in pipeline compressor design, which is available to a considerable degree in the standard De Laval single stage pipeline compressor. Some applications, however, require an exceptionally wide range, and the De Laval Series-Parallel centrifugal compressor has been designed to meet that need.

A good example is the De Laval Series-Parallel 6,350 hp compressor, shown in the photograph at left. It is one of three identical units serving booster stations of the Trunkline Gas Company.

S-P compressors are multi-stage units with the impellers arranged in two groups. Two inlet nozzles permit operating the impeller groups in series or in parallel as shown in the flow diagram. Within the horsepower limits of the driver, the compressor can be transformed from a high-flow, low-head machine to a low-flow, high-head unit *simply by operation of the external valving.* No changing of parts, not even a shutdown is necessary.

The reliability and economy of De Laval centrifugal compressors have been proved in natural gas transmission service throughout the country. You will find it pays to look to De Laval . . . the company that has specialized in the development of these units. De Laval pipeline compressors are operating in sizes from 2500–15,000 hp and with all types of drivers—gas turbines, gas engines, steam turbines and electric motors.



For additional information, write for the article "Tailoring Centrifugal Compressors for Pipe Lines" as well as De Laval Bulletin 503.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
869 Nottingham Way, Trenton 2, New Jersey

DL-309

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Here's a good, small wheel-type Trenchliner, in the popular low-price range, that digs up to 18 lineal feet of trench per minute, 12 to 24 inches wide at depths to 5¾ feet. Hydraulic power raises and lowers the wheel on vertical mast with fractional-inch accuracy — and tilts the mast for traveling or trailer-loading. A shiftable, reversible belt conveyor gives controlled discharge (hydraulic conveyor drive optional). This low-cost 130 also has cast-steel buckets with self-sharpening, reversible "Tap-In" teeth, quick-change gumbo buckets, retractable bucket-cleaner, etc. It's heavy-duty, high-quality in every detail.

Look at the work range of this medium-size 170 Trenchliner, with its extra-wide wheel-frame. You get trench widths from 20 to 32 inches — depths to 5¾ feet — digging speeds up to 25 lineal feet per minute. Hydraulic control on conveyor gives belt speeds up to 600 feet per minute — *completely independent of digging wheel speeds.* Belt easily handles maximum yardages from the extra-wide wheel. Want more facts? See Parsons distributor — or send coupon.

Wide-wheel 170

Mail to: PARSONS COMPANY, Newton, Iowa

Send us literature on: ☐ 130 ☐ 170 *Trenchliner*

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Your pipeline operation is as efficient—and profitable—as its control communications system.

That simple fact emphasizes the importance of a properly designed system to insure unfailing reliability and flexibility for future growth.

Westinghouse fills the bill by providing the ultimate in circuit simplicity designed specifically for ease of maintenance and interchangeability. Multiplex panels allow up to 30 crystal-controlled channels capable of carrying up to 15 sub-channels for telegraph, teletype, telemetering or supervisory control. Westinghouse system design incorporates automatic alarm and *100% stand-by* for interruption-free service. Above all, Microwave gets through, without wires subject to weather or accident damage.

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Hydraulic Torque Converter Drive
Weight — 78,250-lb tractor and side boom with full counterweight
127,000-lb lifting capacity at 4-ft overhang

Here the two HD-21's are lowering the heavy concrete-weighted pipe into a trench at the river bank. Outstanding stability of tractor plus quick, easy control of side boom and counterweights, permits booming out big loads smoothly, safely.

HD-21's handled the big lift on a Trans-Canadian river crossing

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

Two Allis-Chalmers HD-21 tractors with Tractomotive side booms handled the big lifts for Marine Pipeline and Dredging Ltd. on the Red River crossing for Trans-Canada Pipe Lines Ltd. The job involved handling 2,017 ft of 34-in. dia. concrete-weighted pipe weighing 1,200 lb per foot. The two HD-21's lifted section by section of pipe and traveled with it while a machine on the opposite bank pulled the pipe across the river.

Marine Pipeline President, Glen Kennedy, stated, "These HD-21's not only lift the big loads, they can run with them, too. They've really got the capacity and balance to handle the heavy pipe."

The tractor-side boom units, together with other spread equipment, worked a 70-hour week on this job. Operators particularly liked the way the HD-21 handled under heavy loads and the easy, positive control of the side boom.

Allis-Chalmers-Tractomotive offers three tractor side boom sizes to fit your pipe-line requirements. Choose the most modern pipeline equipment available today — see your Allis-Chalmers construction machinery dealer.

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What is Economic Pipe Size?

Here is a fast method of finding out, one that will give proper balance between pipeline and station investment and operating cost

C. J. Shelton, Jr.
Creole Petroleum Corporation
Caracas, Venezuela

ONE OF THE PRIMARY responsibilities of a pipeline designer is to determine the proper balance between pump station and pipeline facilities to give the lowest investment and operating cost consistent with sound engineering practice.

Purpose of this paper is to present a rapid method for determining economic pipe diameter for a given set of conditions. In many cases this method gives the final answer to the selection of economic pipe size. In others it will serve only as a guide, narrowing the range of diameters, which must be studied in more detail.

In order to determine the economic diameter, equations are developed to express the most important variables affecting system investment and operating expenses and their relationship to pipe diameter.

Definition of Symbols

°API = Crude gravity at flowing temperature in degrees API.

A = Cost of pipe delivered to warehouse or central distribution point in $/ton.

B = Pipeline construction costs which for small differences in diameter are essentially a straight-line function of pipe diameter for a given wall thickness, $/foot of outside diameter/mile.

C_L = Annual pipeline and pump station operating expense for laminar flow, $.

C_T = Annual pipeline and pump station operating expense for turbulent flow, $.

d_L = Annual depreciation rate on pipeline investment expressed as a decimal.

d_S = Annual depreciation rate on pump station investment expressed as a decimal.

D = Pipe diameter, ft.

E = Estimated pump efficiency for crude viscosity at flowing temperature expressed as a decimal.

f = Friction factor in flow equations.

F = Annual pipeline maintenance and operating cost, which vary with diameter expressed as a decimal function of investment.

G = Annual pump station maintenance and operating costs, which vary with horsepower, $/hp year.

I_L = Total pump station and pipeline investment for laminar flow.

I_T = Total pump station and pipeline investment for turbulent flow.

$$K_L = \frac{195.2 \times 10^{-10} Q^2 V}{131.5 + °API}$$

$$K_T = \frac{527.8 \times 10^{-12} Q^{2.75} V^{0.25}}{131.5 + °API}$$

N_{Re} = Reynolds number.

Q = Design flow rate, bbl/day. This rate must be the maximum daily rate for lines operating only a portion of the day. For instance, if a gathering line throughput is 10,000 bbl/day and the line operates only 12 hours, the design rate is 20,000 bbl/day.

$R_C = \left(d_S + \frac{G}{S}\right)\left(\frac{1}{d_L + F}\right)$ = ratio of pump station to pipeline operating costs affecting economic diameter.

$R_I = \left(\frac{S}{E} \times \frac{1}{4061\ At + B}\right)$ = ratio of pump station to pipeline investment affecting economic diameter.

S = Pump station material and construction costs, $/hp. This value covers only the horsepower required. If standby is to be installed, this value must be multiplied by the ratio of standby desired. For example if 25 percent standby is desired and the cost is $400/hp installed, S = 1.25 × 400 = $500.

t = Nominal pipe wall thickness, ft.

T = Tons of line pipe/mile.

V = Crude viscosity at flowing temperature in centistokes.

I. Determination of diameter for minimum investment in laminar flow. For the simpler case of laminar flow for Reynolds number 2100 or less, the elements of system investment and operating costs that influence economic pipe diameter are evaluated as follows:

The steel tonnage required per mile of line pipe is:

$$5280 \text{ ft/mile} \times \frac{\pi}{4} [(D + 2t)^2 - D^2] \times \frac{\text{ton}}{2000 \text{ lb}} \times 489 \text{ lb/ft}^3, \text{ or } T = 4061\,(D + t)t \quad . \quad (1)$$

For small increments of diameter, construction costs consist of a constant plus a cost that varies with diameter. That portion of cost which is a constant need not be considered,

for it cancels out in the economic comparison. Items such as right-of-way, survey, and clearing are essentially constant; whereas stringing, welding, laying, coating and wrapping, etc., are functions of diameter and wall thickness.

It is necessary to assume a pipe wall thickness using this method; however, the assumed value can be changed easily, as will be seen later in the final equations. Also, it should be noted that wall thickness is often determined by considerations other than those of operating pressure. When maximum pressures do require a wall thickness greater than that assumed, the situation can be remedied by reducing station spacing and/or increasing the wall thickness at the station discharge.

For a constant wall thickness, the line construction cost can be expressed as a function of outside pipe diameter, or B(D + 2t). Total pipeline investment per mile excluding fixed costs is:

$$\text{Pipeline investment/mile} = 4061\,A(D + t)\,t + B\,(D + 2t) \quad \ldots\ldots\ldots \quad (2)$$

Friction loss per mile of pipe is expressed by the Hagen-Poiseuille Law for laminar flow:

$$\text{Psi/mile} = \frac{28.7 \times 10^{-5} QV}{D^4(131.5 + {}^\circ\text{API})} \quad \ldots \quad (3)$$

The required horsepower per mile is Equation 3 multiplied by the standard horsepower equation:

$$\text{Hp required/mile} = \frac{17 \times 10^{-6} Q}{E} \times \frac{28.7 \times 10^{-5} QV}{D^4(131.5 + {}^\circ\text{API})} \quad \ldots\ldots\ldots \quad (4)$$

Pump station construction cost can be expressed as a constant plus a cost that varies with horsepower installed. Again the fixed cost will cancel out in the economic comparison, so only the variable need be considered.

The Author

C. J. Shelton, Jr., *is senior engineer II, Creole Petroleum Corporation's Western Division pipeline office at Maracaibo, Venezuela. He received a bachelor of industrial engineering degree from Georgia Institute of Technology in 1947. He worked two years for Tennessee Gas Transmission Company and three years for Texas Eastern Transmission Corporation prior to joining Creole in November 1952. His home town is Gulfport, Mississippi.*

From Equations 2 and 4 the system investment per mile is:

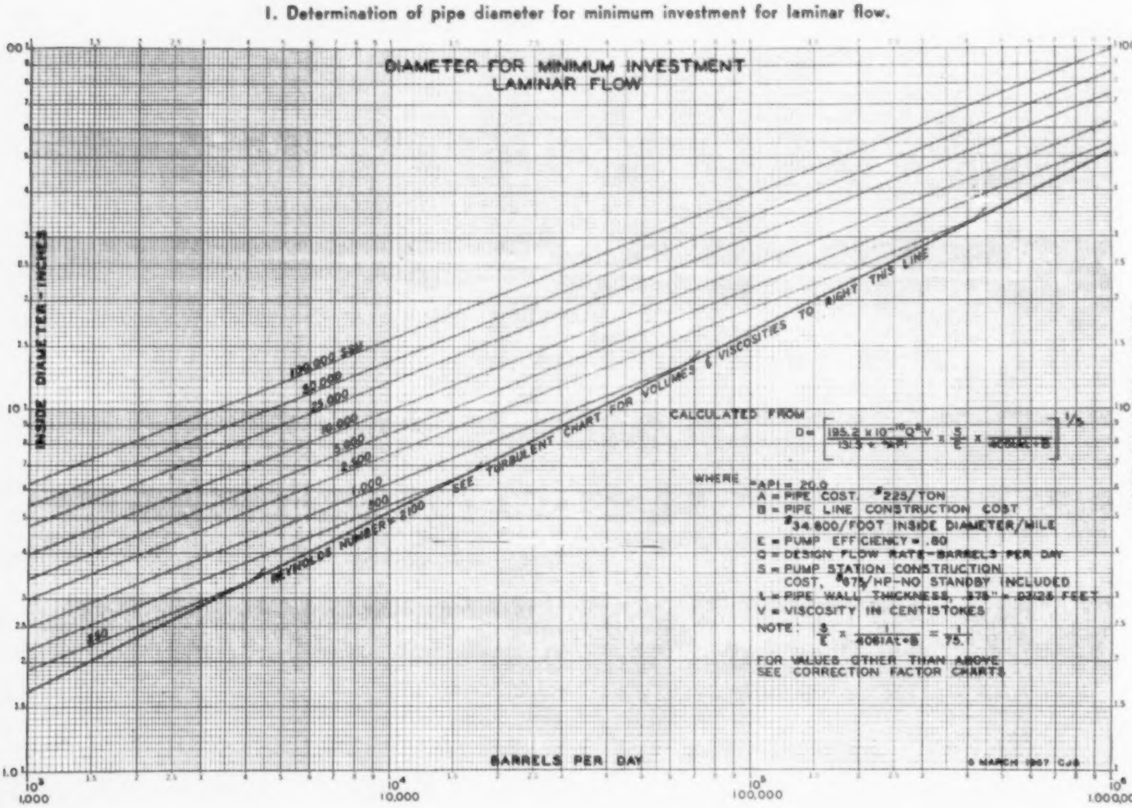
$$I_L = 4061\,At\,(D + t) + B\,(D + 2t) + \frac{48.8 \times 10^{-10} S\,Q^2 V}{E\,D^4(131.5 + {}^\circ\text{API})} \quad \ldots\ldots \quad (5)$$

For a given problem the crude volume and characteristics are known. Values for the cost elements can be determined from current cost data. Equation 5 defines the system investment as a function of all important variables with diameter the only unknown.

Differentiating investment with respect to diameter and solving for the minimum:

$$D = \left[\underbrace{\frac{195.2 \times 10^{-10} Q^2 V}{(131.5 + {}^\circ\text{API})}}_{\substack{\text{Constant for given}\\\text{crude volume and}\\\text{characteristics}}} \times \underbrace{\frac{S}{E}}_{\substack{\text{Pump station}\\\text{investment}}} \times \underbrace{\frac{1}{4061\,At + B}}_{\substack{\text{Pipeline}\\\text{investment}}} \right]^{1/6} \quad \ldots\ldots \quad (6)$$

1. Determination of pipe diameter for minimum investment for laminar flow.



Equation 6 can be stated as:

$$D = (K_L R_I)^{1/5},$$

which clearly shows that for a given crude volume and characteristic, the diameter that gives minimum investment is proportional to the fifth root of the ratio of station to line investment. Absolute values of the station and pipeline investments are not important as long as the ratio is correct. Actually, the ratio can be considerably in error and still not affect the economic diameter; for instance, a 50 percent error in the ratio results in $(1.5)^{1/5}$ or 8.5 percent in the diameter. In many cases this is less than the difference between consecutive diameters commercially available. A change of 50 percent in design volume would result in $(1.5)^{2/5}$ or a 17.6 percent error in economic line size.

II. Determination of diameter for minimum operating expense for laminar flow. Annual operating expenses can be expressed in terms of dollars per horsepower year, dollars per foot of diameter, and/or as a percentage of investment. Equation 5 can be modified as follows to express annual operating expenses:

$$C_L = (d_L + F)\,[4061\,A(D + t)\,t + B(D + 2t)] + (Sd_S + G)\,\frac{48.8 \times 10^{-10} Q^2 V}{E\,D^4(131.5 + °API)} \quad . \quad . \quad . \quad (8)$$

Differentiating expense with respect to diameter and solving for the minimum:

$$D = \Bigg[\underbrace{\frac{195.1 \times 10^{-10}\,Q^2\,V}{(131.5 + °API)}}_{\text{Constant for given crude volume and characteristics}} \times \underbrace{\frac{Sd_S + G}{E}}_{\text{Station costs}} \times \underbrace{\frac{1}{(d_L + F)\,(4061\,At + B)}}_{\text{Pipeline costs}}\Bigg]^{1/5} \quad . \quad . \quad . \quad . \quad (9)$$

This equation can be simplified to:

$$D = (\text{Diameter for minimum investment}) \times \left[\underbrace{\left(d_s + \frac{G}{S}\right)}_{\text{(station)}}\underbrace{\left(\frac{1}{d_L + F}\right)}_{\text{(line)}}\right]^{1/5} \quad . \quad . \quad . \quad (10)$$

$$D = \text{Diameter for minimum investment} \times (R_c)^{1/5},$$

which says that once the diameter for minimum investment is determined, the diameter for minimum operating expense can be found by multiplying it by the one-fifth root of the ratio of operating costs for station to line.

Here again it is apparent from Equation 9 that rather appreciable errors in the various elements of cost comprising the system operating expense have a proportionally small influence on diameter.

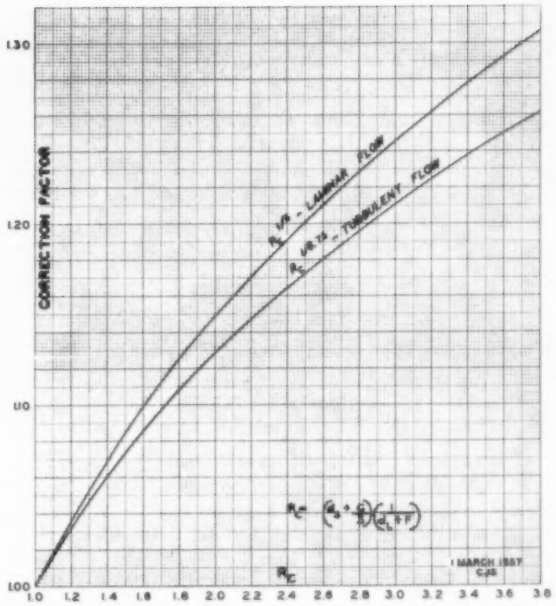
A simplified method of calculating payout of the diameter for minimum operating expense over that for minimum investment is covered later.

III. Determination of diameter for minimum investment in turbulent flow. In deriving the equations for economic diameter in turbulent flow, the decision has to be made as to which of the many equations for friction factor to use. We have found that Blasius' equation gives results sufficiently accurate for determination of economic line diameter, although Moody's values for friction factor as presented in the Standards of Hydraulic Institute are used for all detailed hydraulic calculations.

Pipeline investment will be the same as Equation 2 under the laminar flow section. From the Weisbach-Darcy equation, friction loss is:

$$\text{Psi/mile} = \frac{3.44 \times 10^{-5}\,f\,Q^2}{D^5(131.5 + °API)} \quad . \quad . \quad (11)$$

Blasius' equation for friction factor is $0.316\,N_{Re}^{-0.25} = 0.316\left(\frac{DV}{7.69\,Q}\right)^{0.25}$ . . . . . (12)



2. Correction factors for operating expenses. Diameter for minimum operating costs is diameter for minimum investment multiplied by appropriate factor from curves in graph.

Substituting for friction factor in Equation 11:

$$\text{Psi/mile} = \frac{6.54 \times 10^{-6}\,Q^{1.75} V^{0.25}}{D^{4.75}(131.5 + °API)} \quad . \quad . \quad (13)$$

Horsepower required per mile becomes:

$$\text{Hp/mile} = \frac{111.1 \times 10^{-12}\,Q^{2.75}\,V^{0.25}}{E\,D^{4.75}(131.5 + °API)} \quad . \quad . \quad (14)$$

From Equations 2 and 14 the system investment is:

$$I_T = 4061\,A(D + t)\,t + B\,(D + 2t) + \frac{111.1 \times 10^{-12}\,S\,Q^{2.75}\,V^{0.25}}{E\,D^{4.75}(131.5 + °API)} \quad . \quad . \quad . \quad (15)$$

Differentiating investment with respect to diameter and solving for the diameter which gives minimum investment,

$$D = \Bigg[\underbrace{\frac{527.8 \times 10^{-12}\,Q^{2.75}\,V^{0.25}}{131.5 + °API}}_{\text{Constant for given crude volume and characteristics}} \times \underbrace{\frac{S}{E}}_{\text{Station investment}} \times \underbrace{\frac{1}{4061\,At + B}}_{\text{Line investment}}\Bigg]^{1/5.75} \quad . \quad . \quad . \quad . \quad (16)$$

Simplifying to:

$$D = (K_T R_I)^{1/5.75}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

it can be seen again that only the ratio of station to line investment is important. An error of 50 percent in this investment ratio results in $(1.5)^{1/5.75}$ or 7.3 percent error in economic diameter.

An investment ratio of 1:75.1 was used in the graphs of diameter for minimum investment appearing at the end of this article. Although absolute values for pipeline and pump station investments may vary considerably between land and water installations and between U. S. and foreign systems, the data available to us show that the graph values based on this 1:75.1 ratio usually indicate, within commercially available sizes, the correct diameter for minimum investment. As a general rule, the diameter one size larger than that read on the graph for minimum investment will result in the best solution considering both investment and operating costs.

IV. Determination of diameter for minimum operating expense in turbulent flow. Annual operating expenses are:

$$C_T = (d_L + F)\,[4061\,A(D + t)\,t + B(D + 2t)] + \frac{(Sd_s + G)\,(111.1 \times 10^{-12} Q^{2.75} V^{0.25})}{E\,D^{4.75}(131.5 + {}^\circ API)} \quad . \quad . \quad (18)$$

and diameter for minimum operating expense is:

$$D = \Bigg[\underbrace{\frac{527.8 \times 10^{-12} Q^{2.75} V^{0.25}}{(131.5 + {}^\circ API)}}_{\text{Constant for given crude volume and characteristics}} \times \underbrace{\frac{Sd_s + G}{E}}_{\text{Station costs}} \times \underbrace{\frac{1}{(d_L + F)\,(4061\,At + B)}}_{\text{Line costs}}\Bigg]^{1/5.75} \quad . \quad . \quad . \quad . \quad (19)$$

which can be stated as:

D = (Diameter for minimum investment) $\times$

$$\left[\left(d_s + \frac{G}{S}\right)\left(\frac{1}{d_L + F}\right)\right]^{1/5.75} \quad . \quad . \quad . \quad . \quad (20)$$

D = (Diameter for minimum investment) $\times\ (R_c)^{1/5.75}$

V. Calculation of payout for laminar flow. For the purpose of payout calculations, the system investment Equation 5 can be considerably simplified. Substituting the diameter for minimum investment, Equation 6, in the investment Equation 5, the following relationship results:

Pipeline investment = 4 $\times$ station investment, or

$$\text{investment} = \text{pipeline investment} + \frac{\text{pipeline investment}}{4}$$

For purposes of payout, only those terms containing diameter will change, and pipeline investment is D(4061 At + B). The investment can be stated as:

$$D\Bigg(\underbrace{4061\,At + B}_{\text{Pipeline}} + \underbrace{\frac{4061\,At + B}{4}}_{\text{Station}}\Bigg) \quad . \quad . \quad (21)$$

This condition is true only for the *exact diameter* which gives minimum investment.

For any other condition, it can be seen from Equation 5 that pipeline investment is directly proportional to diameter and pump station investment is proportional inversely to the fourth power of the diameter.

Letting D_1 = diameter for minimum investment and D_2 = any other diameter, Equation 21 for difference in investment between D_1 and D_2 becomes:

$$I = \underbrace{(D_2 - D_1)\,(4061\,At + B)}_{\text{Pipeline}} + \underbrace{D_1 \frac{(4061\,At + B)}{4}}_{\text{Station}} \left[\left(\frac{D_1}{D_2}\right)^4 - 1\right] \quad . \quad . \quad . \quad . \quad . \quad (22)$$

Using the known values for pipeline and station depreciation, maintenance, and operating expenses, the payout can be easily calculated.

VI. Calculation of payout — turbulent flow. From Equations 6 and 16, it can be shown that for the *exact diameter* that gives minimum investment the pipeline investment is 4.75 times the station investment. Using the same method as under laminar flow above, the difference in investment between D_1, the diameter for minimum investment, and D_2, any other diameter, is:

$$I = (D_2 - D_1)\,(4061\,At + B) + \frac{D_1\,(4061\,At + B)}{4.75} \left[\left(\frac{D_1}{D_2}\right)^{4.75} - 1\right] \quad . \quad . \quad . \quad . \quad . \quad (23)$$

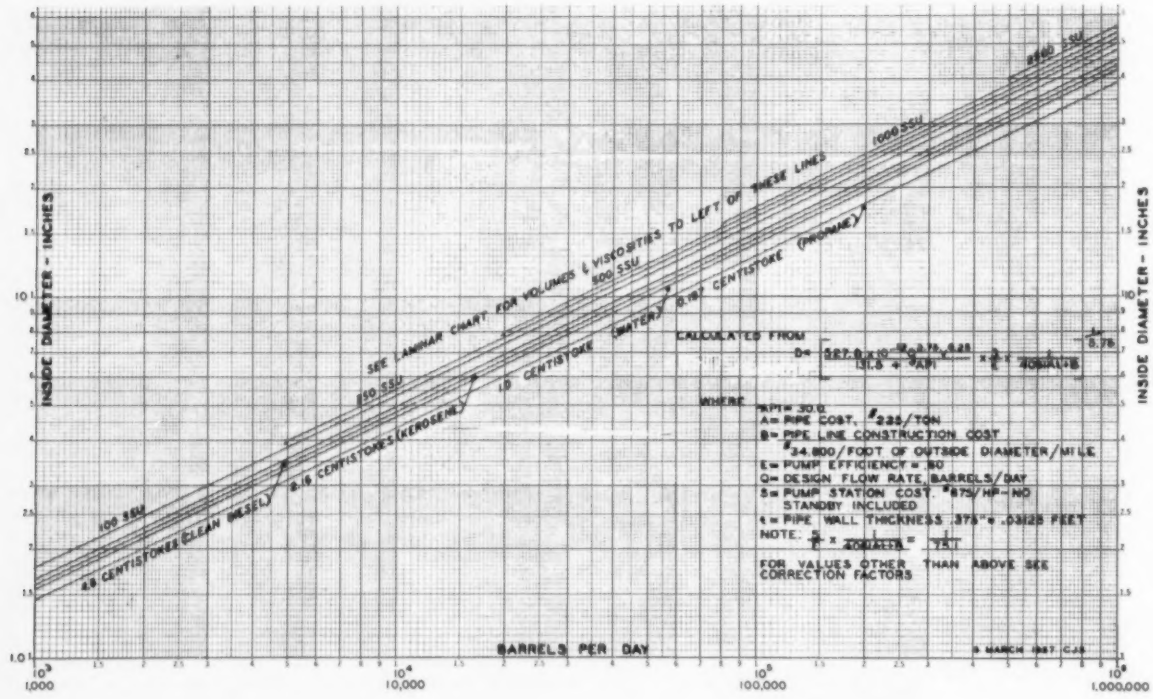
From known values of d_L, d_s, S, F, and G, the payout of the difference in investment can be calculated.

Payout can be calculated from the following:

Let I = Investment difference
C = Difference in operating cost excluding depreciation
d = Difference in depreciation

$$\text{Payout, years} = \frac{I}{(1 - \text{tax rate})\,C + (\text{tax rate})\,d} \quad . \quad (24)$$

3. Determination of pipe diameter for minimum investment for turbulent flow.



VII. Calculation of graphs for diameter for minimum investment.

(A) *Laminar flow.*

°API = 20.0

A = Pipe cost, $225/ton

B = Pipeline construction cost, $34,800/ft outside diameter/mile

E = Pump efficiency, 0.80

R_I = Ratio of station to pipeline investment

$$= \frac{S}{E} \times \frac{1}{4061\,At + B} = \frac{675}{0.8} \times \frac{1}{4061 \times 225 \times 0.03125 + 34{,}800} = \frac{1}{75.1}$$

S = Pump station construction cost, $675/hp with no standby included

t = Wall thickness, ⅜ in. = 0.03215 ft

From Equation 6:

$$D = \left[\frac{195.2 \times 10^{-10} Q^2 V}{(131.5 + °API)} \times \frac{S}{E} \times \frac{1}{4061\,At + B}\right]^{1/5}$$

$$D = \left[\frac{195.2 \times 10^{-10}}{(131.5 + 20)} \times \frac{1}{75.1} \times Q^2 V\right]^{1/5} = 4.44 \times 10^{-3}\, Q^{0.4}\, V^{0.2}$$

$$D'' = 12 \times 4.44 \times 10^{-3}\, Q^{0.4}\, V^{0.2} = 0.0533\, Q^{0.4}\, V^{0.2}$$

Viscosity SSU Centistokes	$V^{0.2}$	$Q^{0.4}$ =	Q = 20 MBD 52.5	100 MBD 100	300 MBD 155.1	500 MBD 190.5
			Diameter in inches for minimum investment			
250	54.6	2.23	6.24	11.86	18.43	22.64
500	110	2.56	7.16	13.64	21.16	25.99
1,000	220	2.94	8.23	15.67	24.30	29.85
2,500	550	3.54	9.91	18.87	29.26	35.94
5,000	1100	4.06	11.36	21.64	33.56	41.22
10,000	2200	4.66	13.04	24.84	38.52	47.32
25,000	5500	5.60	15.67	29.85	46.29	56.86
50,000	11000	6.43	17.99	34.27	53.16	65.29
100,000	22000	7.39	20.68	39.39	61.09	75.04

(B) *Turbulent flow.*

°API = 30

A = $225/ton

B = $34,800/ft outside diameter/mile

E = 0.80

R_I = 1/75.1

S = $675/hp

t = 0.03125 ft

From Equation 16:

$$D = \left[\frac{527.8 \times 10^{-12} Q^{2.75} V^{0.25}}{131.5 + °API} \times \frac{S}{E} \times \frac{1}{4061\,At + B}\right]^{1/5.75}$$

$$D = \left[\frac{527.8 \times 10^{-12}}{131.5 + °API} \times \frac{1}{75.1} \times Q^{2.75} \times V^{0.25}\right]^{1/5.75} = 0.00476\, Q^{0.478}\, V^{0.0435}$$

$$D = 12 \times 476 \times 10^{-5} Q^{0.478} V^{0.0435} = 0.0571\, Q^{0.478}\, V^{0.0435}$$

Viscosity SSU Centistokes	$V^{0.0435}$	$Q^{.478}$ =	Q = 5 MBD 58.6	20 MBD 114.1	100 MBD 246	300 MBD 417.4
			Diameter in inches for minimum investment			
	0.197	0.932	3.12	6.07	13.09	22.21
31.5	1.0	1.000	3.35	6.52	14.05	23.83
34.5	2.16	1.034	3.46	6.74	14.52	24.64
41.8	4.8	1.071	3.58	6.98	15.04	25.53
100	20.7	1.141	3.82	7.43	16.03	27.19
250	54.6	1.190	3.98	7.75	16.72	28.36
500	110	1.227	4.11	7.99	17.24	29.24
1000	220	1.262	4.22	8.22	17.73	30.08
2500	550	1.316	4.40	8.57	18.49	31.36

VIII. Loop required with increase in throughput.

(A) *Solution for minimum investment.*

Earlier it was shown that for the *exact diameter* that gives minimum investment in laminar flow, the ratio of pipeline to station investment, is 4 to 1, or the system investment is five times the station investment.

The horsepower required is a function of the volume squared. From this and the above relationship, an equation can be written to determine what increase in volume requires an increased investment in pump station equal to the cost of a loop line of the same diameter as the original line.

Let Q_1 = Initial volume

Q_2 = Final volume

$$\left(\frac{Q_2}{Q_1}\right)^2 - 1 = 5$$

Station investment for Q_2 — Station investment for Q_1 — Investment for full diameter loop for $Q_2 - Q_1$

From this equation the ratio of Q_2 to Q_1 is 2.45, which says that with an increase of 145 percent in throughput the investment for a loop line is equal to that for installing additional horsepower on the original system.

For turbulent flow the equation becomes:

$$\left(\frac{Q_2}{Q_1}\right)^{2.75} - 1 = 5.75$$

Station investment for Q_2 — Station investment for Q_1 — Investment for full diameter loop for $Q_2 - Q_1$

In this case, the ratio of Q_2 to Q_1 for equal investments is 2, or for a 100 percent increase in volume the loop cost is equal to the increased station investment on the original line.

Taking the volume that gives minimum investment for the diameter installed as a base, it is cheaper from an investment standpoint to handle volume increases up to 145 percent in laminar and 100 percent in turbulent flow by installing additional horsepower on the system. In general, there is no combination of horsepower and loop of any diameter that results in a lower investment than horsepower alone for volume increases up to the stated values. It is also generally true that a line should not be looped with one of lesser diameter because it is cheaper to install additional horsepower on the original system. Likewise, if a partial loop can be justified by savings in operating expenses of pump stations, a full loop can be justified.

For equal investments, the pump station maintenance and operating expenses are usually considerably higher than those for pipeline. For this reason, a loop line of equal or larger diameter will show an attractive payout before volume increases reach the 145 percent and 100 percent values for laminar and turbulent flows respectively.

(B) *Loop required to maintain constant discharge pressure.*

In some cases it is desirable to install a partial loop of the same diameter as the original line to maintain a constant discharge pressure at a given station. This requirement can occur either in a gravity system with a fixed head available or in a pressure system where maximum pressure is limited by equipment already installed and it is not desired to install additional pump stations.

From Equations 3 and 13 the following relationships result for determination of the loop of the same diameter required to maintain a fixed pressure at the initial end of the line:

$$\text{Laminar flow, } X = \frac{2L\,(Q_2 - Q_1)}{Q_2} \quad . \quad . \quad . \quad . \quad . \quad (25)$$

$$\text{Turbulent flow, } X = \frac{1.487\,L(Q_2^{1.75} - Q_1^{1.75})}{Q_2^{1.75}} = 1.487\,L\left[1 - \left(\frac{Q_1}{Q_2}\right)^{1.75}\right] \quad . \quad . \quad . \quad (26)$$

Where:

L = Length of line
X = Length of loop
Q_1 = Initial volume
Q_2 = New volume

The following useful equations for volume split in looped lines of different diameters also can be derived from Equations 3 and 13.

Letting Q represent the total volume, Q_1 the volume in line of inside diameter d_1, etc.,

Laminar flow

(27a) . . . . .

$$Q_1 = \frac{Q \times d_1^4}{d_1^4 + d_2^4 + d_n^4}$$

(28a) . . . . .

$$Q_2 = \frac{Q \times d_2^4}{d_1^4 + d_2^4 + d_n^4}$$

(29a) . . . . .

$$Q_n = \frac{Q \times d_n^4}{d_1^4 + d_2^4 + d_n^4}$$

Turbulent flow

(27b) . . . . . .

$$Q_1 = \frac{Q \times d_1^{2.714}}{d_1^{2.714} + d_2^{2.714} + d_n^{2.714}}$$

(28b) . . . . . .

$$Q_2 = \frac{Q \times d_2^{2.714}}{d_1^{2.714} + d_2^{2.714} + d_n^{2.714}}$$

(29b) . . . . . .

$$Q_n = \frac{Q \times d_n^{2.714}}{d_1^{2.714} + d_2^{2.714} + d_n^{2.714}}$$

For one line that gives the same friction loss per mile as several other lines with the same total flow rate:

Laminar flow

(30a) . . . . .

$$d_E^4 = d_1^4 + d_2^4 + d_n^4$$

Turbulent flow

(30b) . . . . . .

$$d_E^{2.714} = d_1^{2.714} + d_2^{2.714} + d_n^{2.714}$$

where d_E is the line equivalent to lines $d_1 + d_2 + d_n$.

Exponential functions of diameter for 0.375-in. wall thickness pipe are given in Table (E) under Section IX.

IX. Correction Factor Tables.

(A) Crude gravity.

Actual °API	Multiply graph diameter by: Laminar	Turbulent
10	1.014	
15	1.007	
20	1.000	1.011
25	0.994	1.005
30	0.987	1.000
35	0.981	0.995
40		0.990
45		0.985
50		0.980

(B) Investment ratio.

Actual R_I°	Multiply graph diameter by: Laminar	Turbulent
1/35	1.165	1.142
1/40	1.134	1.116
1/45	1.108	1.093
1/50	1.085	1.073
1/55	1.064	1.055
1/60	1.046	1.039
1/65	1.029	1.025
1/70	1.014	1.012
1/75	1.000	1.000
1/80	0.987	0.989
1/85	0.975	0.978
1/90	0.964	0.969
1/95	0.954	0.960
1/100	0.944	0.951
1/105	0.935	0.943
1/110	0.926	0.936
1/115	0.918	0.929
1/120	0.910	0.922
1/125	0.903	0.915
1/130	0.896	0.909
1/135	0.889	0.903
1/140	0.883	0.897
1/145	0.876	0.892
1/150	0.870	0.886

$$^{\circ} R_I = \frac{S}{E} \times \frac{1}{4061\,At + B}$$

(C) Operating expenses.

R_C°	Multiply graph diameter by: Laminar	Turbulent
1.00	1.000	1.000
1.20	1.037	1.032
1.40	1.070	1.060
1.60	1.099	1.085
1.80	1.125	1.100
2.00	1.149	1.128
2.20	1.171	1.147
2.40	1.192	1.164
2.60	1.211	1.181
2.80	1.229	1.196
3.00	1.246	1.211
3.20	1.262	1.224
3.40	1.278	1.237
3.60	1.292	1.250
3.80	1.306	1.261

$$^{\circ} R_c = \left(d_c + \frac{G}{S}\right)\left(\frac{1}{d_L + F}\right)$$

(D) Viscosity for economic diameter when batching.

When several crudes of different characteristics are batched through one pipeline, there are two methods of determining the economic diameter. The first and easiest is to use the weighted gravity and the viscosity determined by blending the various crudes on viscosity blending paper. The second method is to take the viscosity determined as follows:

Laminar:

$$V = [\%\ V_1\ (V_1)^{1/5} + \%\ V_2\ (V_2)^{1/5} + \%\ V_n\ (V_n)^{1/5}]^5$$

Turbulent:

$$V = [\%\,V_1(V_1)^{0.0435} + \%\,V_2(V_2)^{0.0435} + \%\,V_n(V_n)^{0.0435}]^{23}$$

Where:

V = Viscosity to use in determination of economic diameter

V_1, V_2, etc. = Viscosity of particular crude

$\%\ V_1$ = Percent of crude of V_1 viscosity characteristics

(E) Diameter functions.

Nominal size, in.	d	Diameter functions in feet for 0.375-in. wall thickness $d^{2.714}$	d^4	$d^{4.75}$	d^5	$d^{5.75}$
4	0.3125	0.0422	0.0095	0.0040	0.0030	0.0013
6	0.4896	0.144	0.0575	0.0335	0.028	0.0163
8	0.6563	0.319	0.186	0.135	0.122	0.089
10	0.8333	0.609	0.481	0.420	0.400	0.350
12	1.0000	1.000	1.000	1.000	1.000	1.000
14	1.1042	1.377	1.486	1.601	1.641	1.766
16	1.2708	1.923	2.610	3.120	3.317	3.963
18	1.4375	2.670	4.260	5.60	6.12	8.05
20	1.6042	3.59	6.60	9.40	10.6	15.1
22	1.7708	4.70	9.84	15.10	17.4	26.6
24	1.9375	5.98	14.0	23.0	27.2	44.8
26	2.1042	7.50	19.6	34.2	41.2	72.0
28	2.2708	9.2	26.5	49.1	60.6	112
30	2.4375	11.5	35.1	68.4	85.8	166
32	2.6042	13.4	46.0	94.3	120	247
34	2.7708	15.8	59.0	126	164	350
36	2.9375	18.4	74.0	165	218	489
38	3.1042	21.5	93.0	218	290	665
40	3.2708	24.6	114	279	371	901
42	3.4375	28.0	138	348	472	1200
44	3.6041	32.1	168	440	608	1600
46	3.7708	34.8	189	505	702	1880
48	3.9375	41.0	238	660	940	2600
50	4.1042	46.0	283	810	1180	3380
52	4.2708	51.0	330	990	1410	4200
54	4.4375	56.3	386	1180	1700	5200
56	4.6042	63.0	450	1410	2080	6500
58	4.7708	66.3	490	1570	2300	7400
60	4.9375	76	590	1960	2900	9500

Sample problems.

A. (1) Determine the diameter that gives minimum investment for 200,000 bbl per day of 250 SSU, 26°API crude. Pump standby of 25 percent is to be installed. Wall thickness is to be 5/16 in. (0.3125 in.). Construction and material costs are as follows:

$A = \$180$/ton
$B = \$10{,}000$/ft outside diameter/mile
$E = 0.85$
$Q = 200{,}000$ bbl/day
$S = \$275/\text{hp} \times 1.25 = \$344$
$t = 0.3125 \text{ in.} = 0.02604 \text{ ft}$

$$R_I = \frac{344}{0.85} \times \frac{1}{4061 \times 180 \times 0.02604 + 10{,}000} = \frac{1}{71.7}$$

From the graph for minimum investment in turbulent flow, $D = 23.4$ in.

By interpolation from Section IX (B), the correction factor for an investment ratio of 1/71.7 is 1.008 and for 26°API gravity, 1.005. The corrected diameter for the problem conditions is $23.4 \times 1.008 \times 1.005 = 23.7$ in. The nearest commercial size is $24 \times 5/16$ in.

(2) Determine the diameter that gives minimum operating expenses when $d_L = d_s = 0.05$, $F = 0.01$,

G = Power cost of 10.36 mils/kwh = \$67.68/hp-yr on operating horsepower or $\$67.68 + 1.25 = \$54.14$ on installed horsepower; maintenance at \$4.00/hp-yr on installed horsepower or:

$G = \$58.14$/hp-yr
$G/S = \$58.14/344 = 0.169$

$$R_c = \left(d_s + \frac{G}{S}\right)\left(\frac{1}{d_L + F}\right) = \left(\frac{0.05 + 0.169}{0.05 + 0.01}\right) = 3.65$$

The correction factor for $R_c = 3.65$ is 1.253, and the diameter for minimum operating expenses is $1.253 \times 23.7 = 29.7$ in. The nearest commercial diameter is 30 in.

(3) Determine the payout of 30 in. over 24 in. with taxes at 50 percent.

The investment difference can be determined using Equation 22 and 23.7 in. inside diameter as the base.

	D	$D^{4.75}$
23.7 in.	= 1.975 ft	25.5
$30 \times 5/16 = 29.375$ in.	= 2.448 ft	70.0
$24 \times 5/16 = 23.375$ in.	= 1.948 ft	23.6

$$4061\,At + B = 4061 \times 180 \times 0.02604 + 10{,}000 = \$29{,}035$$

$$I_{24''} = (1.948 - 1.975)(29{,}035) + 12{,}070\left(\frac{25.5}{23.6} - 1\right)$$

$$= \$-784 + \$972 = \$+188$$
Line Station Total

$$I_{30''} = (2.448 - 1.975) + 12{,}070\left(\frac{25.5}{70.0} - 1\right)$$

$$= +\$13{,}733 - \$7{,}674 = \$6{,}059$$
Line Station Total

The 30-in. line investment is \$13,733 + \$784 = \$14,517 more than the 24-in.

The 30-in. station investment is \$7,674 + 972 = \$8,646 less than the 24-in.

The 30-in. total investment is \$5,871 more than the 24-in.

The 24-in. line maintenance cost is $0.01 \times 14{,}517 = \$145.17$ less than the 30-in.

The 24-in. station operation expense is $0.169 \times 8{,}646 = \$1{,}461.17$ more than the 30-in.

The 24-in. system expense is \$1461.17 – 145.17 = \$1316 more than the 30-in.

The 24-in. system depreciation is $0.05(5871) = \$293.55$ less than the 30-in.

From Equation 23:

$$\text{Payout} = \frac{5871}{(1 - 0.5)(1316) + (0.5)(293.55)} = 7.3 \text{ years}$$

B. (1) What additional investment in horsepower is required if throughput in above line is raised to 300,000 bbl per day?

From Section VI, the station investment is pipeline investment + 4.75 for 23.7-in. diam, or:

$$\text{Station investment} = \frac{D(4061\,At + B)}{4.75} = \frac{1.975 \times 29{,}035}{4.75} = \$12{,}070/\text{mile}$$

Since horsepower required varies inversely with $D^{4.75}$, the station investment for $24 \times 5/16$-in. pipe is $\$12{,}070 \times \frac{25.5}{23.6} = \$13{,}040$/mile for 200,000 bbl per day.

Horsepower required varies as $Q^{2.75}$, so the total station investment required for 300,000 bbl per day is:

$$\left(\frac{300{,}000}{200{,}000}\right)^{2.75} \times \$13{,}040 = 3.05 \times 13{,}040 = \$39{,}770$$

or an increase of \$26,730/mile.

(2) What percentage loop would be required to maintain the same total pressure drop in the system with 300,000 bbl per day as with the 200,000 bbl per day in the single line?

From Equation 25:

$$X = 1.487\,L\,\frac{(300{,}000^{1.75} - 200{,}000^{1.75})}{300{,}000^{1.75}}$$

$$= 1.487\,L\,\frac{(385 - 189) \times 10^7}{385 \times 10^7} = 0.757\,L$$

The required percentage of loop is 75.7 percent.

Summary

Economic pipe diameter for a given system is that which gives the proper balance between pipeline and pump station investment and operating cost. A mathematical analysis of the variables involved shows that the absolute value of unit costs for pipeline and pump stations is not important and that only the ratio of investment and operating costs of these facilities need be considered.

Equations for determination of economic line size are summarized graphically using a ratio of station to line investment that is valid for both land and water installations in U. S. and foreign operations.

Correction tables and graphs permit an exact solution for conditions other than those presented in the graphical summary. An error of 50 percent in estimated ratio of line to station investment results in an error in pipe diameter of only 8.5 percent in laminar flow and 7.3 percent in turbulent flow. Errors of this magnitude usually woud not change the economic line size because of the spread in available pipe diameters. Selection of the pipe diameter one commercial size larger than the exact graph value for minimum investment generally results in the economic system considering both investment and operating costs.

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PROPER LUBRICATION=LONGER COMPRESSOR LIFE

An analysis of lubrication problems in gas and air compressors and how to control them

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Compressor Location and Start-Up

THE BEST planned installation can be easily ruined by fumes, smoke, dust, or moisture from a foundry, furnace, stack, or cooling tower. Compressor performance is affected by placing intake and discharge lines near a very hot or very cold pipe.

In the starting-up procedure all pipes must be blown, flushed, hammered, brushed, or otherwise cleaned to remove pipe scale, welding beads, thread cuttings, dirt, rust, moisture, and other contaminants. Rotary pipe cleaners and/or chemical cleaning are effective ways of loosening scale and other debris in pipes.

Likewise, before making final connections, crankcases and stuffing boxes must be thoroughly cleaned and all lube oil lines flushed and primed.

Breaking in should be done with valves out of the cylinders. Several short runs should be made with oil feeds well opened, allowing for shutdowns and inspection of bearings for heat or lack of lubrication. By gradually increasing the time of each run, moving parts can be run-in and visual inspection will show whether surfaces are beginning to take running polish.

When the rubbing surfaces are properly broken in, valves and stuffing box packing can be installed. They should first be placed in the low-pressure stage, and, as soon as intercoolers and connecting piping are blown out, they can be installed in the successive stages.

Then, gradually close the atmospheric by-pass until the machine is up to full pressure. During the build-up watch carefully for any hot bearings, stuffing boxes, or piston rods. Care during start-up will help establish adequate lubrication and prevent scuffed cylinders, bearings, and rods.

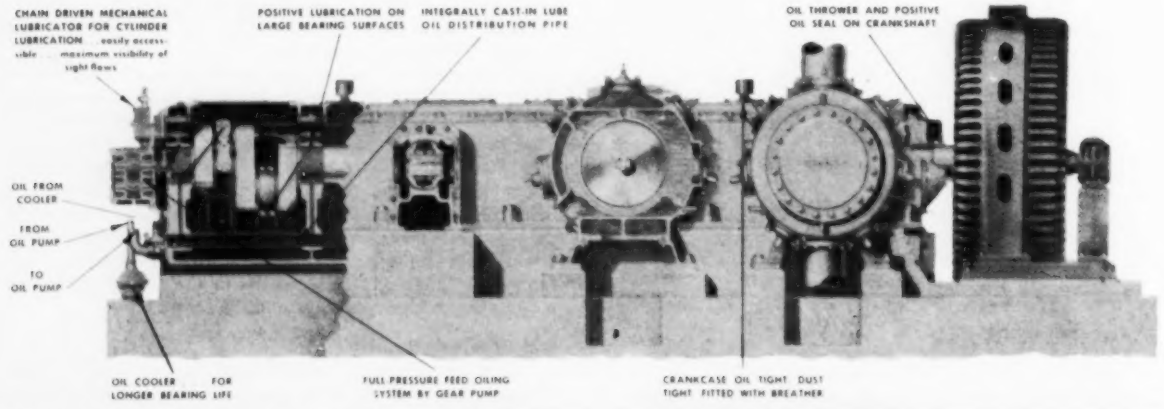
Condensation — A Problem In Winter

Because of water costs, most liquid-cooled compressors depend on a cooling tower. Cooling water off the tower in summer is usually from 10 to 15 F above the dew point of surrounding air. There is little moisture that can collect and dilute the lubricant. Condensation does not take place in the suction passages of an air compressor, and "sweating" does not occur in the cylinder bore. In winter, however, cooling water often is so cold that moisture condenses in both the suction passages and bore, and in the low spots in the suction line.

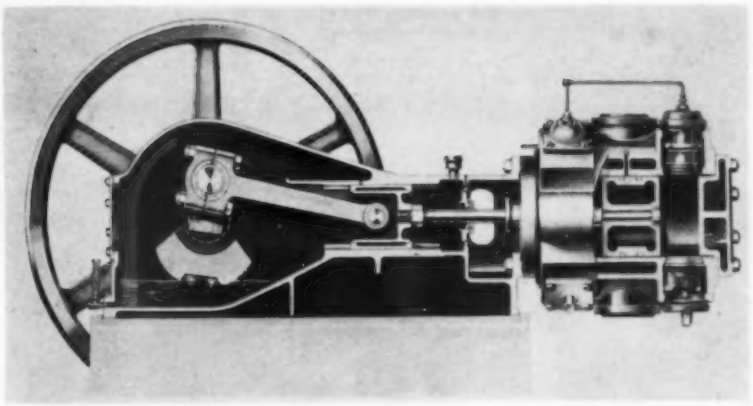
To combat this, an oil should be specified with sufficient compound so that the cylinder walls will be wet in spite of moisture. Better yet, some of the cooling water can be recirculated, maintaining an inlet cooling temperature safely above dew point of the suction gas at the coldest condition. Throttling the cooling water outlet should be avoided because it will not produce proper temperature and flow conditions.

Moisture in Piping

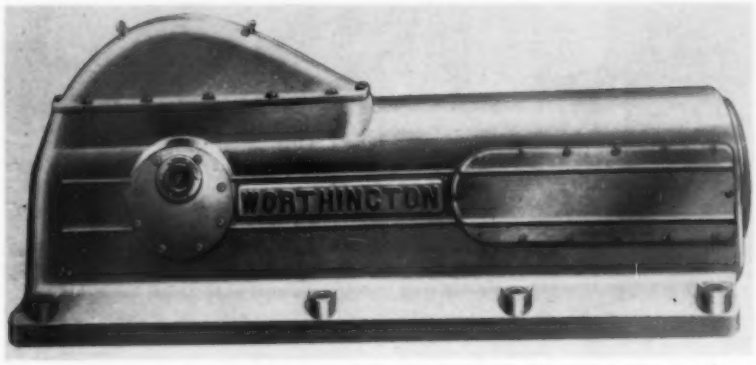
Frequently, compressors giving the trouble just described have piping problems as well. An outside air intake line passing through a water or


CHAIN DRIVEN MECHANICAL LUBRICATOR FOR CYLINDER LUBRICATION — easily accessible — maximum visibility of sight flows
POSITIVE LUBRICATION ON LARGE BEARING SURFACES
INTEGRALLY CAST-IN LUBE OIL DISTRIBUTION PIPE
OIL THROWER AND POSITIVE OIL SEAL ON CRANKSHAFT
OIL FROM COOLER
FROM OIL PUMP
TO OIL PUMP
OIL COOLER FOR LONGER BEARING LIFE
FULL PRESSURE FEED OILING SYSTEM BY GEAR PUMP
CRANKCASE OIL TIGHT DUST TIGHT FITTED WITH BREATHER

Balanced opposed compressor lubrication system.



Splash lubricated cylinder of typical small compressor.



Larger compressors have full pressure feed oiling system for all frame bearings. Each frame has its separate oil pump, which maintains oil pressure on all bearings through drilled channels in the shaft, crankpin, and connecting rods.

snowfilled trench enroute to the compressor is dangerous. If corrosion or pipe strain causes a leak, dirt and moisture will be drawn into the cylinder. At first it may not be noticeable, but as the condition becomes worse, valve and bore wear becomes apparent because of a decrease in capacity. This is another case of moisture washing away the lubricant.

A long discharge line through a cold zone and without proper traps can collect moisture. If the line slopes toward the compressor, moisture returns to the machine when it is stopped. On overnight standing, it may seep into the bore, destroying the lubricant that protects the cylinder until feed is re-established after starting.

Periodic Checkups

It is advisable to check regularly lubrication of compressor bores, valves, and packing. To examine the valve and bore for proper oil film and absence of excessive carbon deposit, remove the suction valve. If beads of moisture are visible or rusty spots are present, you can expect trouble. As previously stated, cooling water may be too cold; suction or discharge line problems may exist; water may be leaking into bores through a gasket between water jacket and cylinder bore; or water may be entering through intake or forecooler or intercooler that has a split tube or faulty condensate drain.

One such routine inspection on a two-stage compressor revealed rapid bore wear, rust on first-stage valves, and moisture throughout the machine. There was an intake through a cleaner on the roof. The intercooler appeared to be flooded with condensate and the drain trap was plugged. Tests proved the intercooler tubes to be tight and not leaking. The drain trap caused the second-stage moisture.

But what caused the moisture in the first stage and rust on first-stage valves? Close examination showed the air intake to be about 30 ft upwind from an atmospheric turbine exhaust. The visible plume of steam never came close to the air intake opening; therefore, exhaust steam was not blamed until it was noticed that small drops of moisture collected on eye-glasses when one stood near the air intake. The visible steam was going away from the air intake, but invisible moisture was being drawn into the compressor. The almost complete rusting away of the intake air cleaner interior was another proof of this. Solution was to increase the oil feeds to the intake passages and bores of the first stage, slightly increase the compound, and move the air intake to the side of the building farther away from the exhaust line.

Cylinder and Packing Lubrication

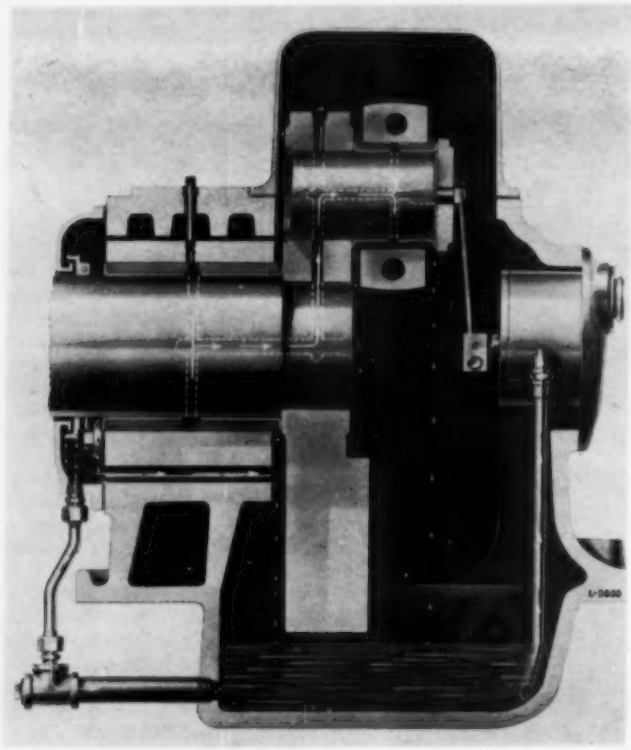
Carbon and gum deposits are the enemy of most machinery. During break-in period, lubrication should be applied to cylinders and packing in quantities to encourage both the flushing away of minute wear particles and formation of the surface glaze or "seating." Proper way to do this is to follow manufacturers' recommendations and use the minimum number of drops of oil per minute. To determine when the minimum has been reached, pull a valve or two and examine cylinder bores, pistons, and rings to see if a thin film of oil (but not puddles) is present everywhere. There should be no dry spots. Metallic packing should be examined in the same manner.

Manufacturers' instruction books usually list the number of drops feed per minute by cylinder bore such as "six inch to eight inch cylinder, one drop per minute," etc. These drops are listed for gravity sight feed lubricators. If sight glasses are liquid filled, drop volume is approximately three times as great. This must be taken into account when adjusting force feed lubricators.

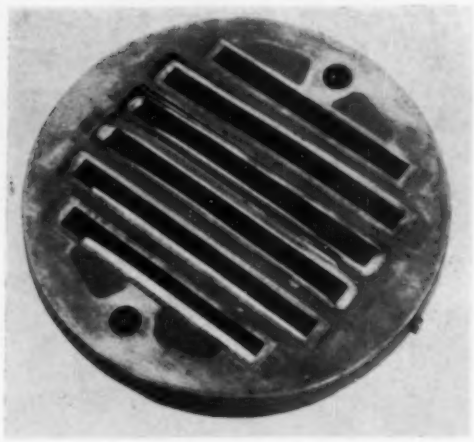
Oil Specification

Viscosity characteristics also must meet manufacturers' recommendations, which frequently differ for crankcase and cylinder. The oil used in the crankcase may be subjected to severe splashing, as in a single horizontal machine where dippers or counterweights pick up oil and distribute it around the machine. Oil for this service therefore must be foam resistant. A force pressure feed crankcase with an oil cooler uses a lower viscosity oil than one without an oil cooler. Normally, the recommendation falls in the range of 60 to 80 SSU at 210 F, but may vary with the type of unit and installation.

For cylinders, packing, and inlet passages, the usual recommendation is a straight run oil with a viscosity of 50 to 60 SSU at 210 F. Flush point of this should always be from 375 to 400 F. If condensate conditions are encountered (as in winter), a three to five percent compound may be added. Oil should be as carbon resistant as possible. This compound cylinder oil should not be used in the crankcase because it may be harmful to babbitted bearings.



Full pressure feed oiling system in duplex compressor.



Effect of excessive moisture on valve seat.

Similar Problems in Process Compressors

Thus far we have limited the discussion to air compressors. But, by no means are problems confined to air compressors. Similar conditions are encountered in process compressors used for refrigeration, air and gas products, gas transmission, field gathering and processing, and petrochemical operations. Because process pressures frequently are much higher than usually encountered in air compressors, the problems are aggravated by corrosion and erosion.

In nearly all industries mentioned, some or all of the compressor cylinders are fed with saturated gas. As with air compressors, care must be taken to minimize the chances of free moisture getting on valves and cylinder walls. To assure reasonable life of cylinder parts in severe or corrosive conditions, forecoolers, separators, and heaters may be required.

To prevent condensation in passages and bore where gas is saturated, jacket water must not be less than 10 to 15 F above the temperature of the suction gas. Process machines frequently are built for higher pressures with multistage construction and high differential pressures per stage. Therefore, precautions must be taken so jacket temperature of each succeeding stage of compression is higher (by 10 to 15 F) than the discharge temperature from the intercooler preceding that stage. It may be difficult to attain this condition in the winter if jacket water is very cold.

Selection of a cylinder lubricant for a process compressor may be difficult if the gas being pumped produces condensate that also is a petroleum product and therefore a solvent or thinning agent for the lubricant.

Some gases react unfavorably with the lubricant and form carbon or gum deposits, causing poor valve action and ring sticking. This eventually results in blow-by. Blow-by, in turn, produces continually increasing heat, which accelerates carbon formation. So, we have a breakdown cycle.

An Example of Carbon Damage

Here's an example of how carryover of chemical in a saturated gas stream produced gum carbon formations in a compressor. The operator of a four-stage compressor observed a hot fourth stage. An examination showed fine carbon in the gas stream and extreme heat coming from this stage. Tracing the heat back through the machine, it was found that intercoolers were hot and were operating off pressure. Also, capacity was down.

The trouble finally was found in the first stage. Suction and discharge valves were covered with so much carbon that nothing could get through them. Caustic vapor saturated the gas stream and reacted with the lube oil, completely plugging the suction valves. This caused heat, and the valves carbonized. More heat caused the discharge valves to carbonize. Because of the plugged first-stage suction and high temperature, the increased overall compression ratio caused more heat to develop. This changed the oil in the fourth stage to carbon dust.

Dirt in Valves and Rings

Some gas streams carry dirt, gum, or precipitate, which deposit on valves and rings. If this condition is bad, scrubbers are indicated. With some gases, these don't do much good. In order to offset this, large quantities of light lube oil or gas oil are fed in with the suction gas stream and to the cylinder bore so the contaminants are washed away. This is not particularly good lubrication and may sometimes be harsh. It is better, however, than trying to pump gas in its raw state with conventional lubrication.

Most compressor lubrication problems are simple to solve if cooling water is maintained at a temperature of 10 to 15 F above dew point of the suction gas and the suction gas is introduced in clean, moisture-free condition at reasonable temperature. When this is accomplished, the only thing needed is to find an oil that is most compatible with existing chemical conditions.

* * *

CORROSION FEATURE

Guide to Selection of Coal Tar Coatings for Protection of Metals Underground

PART 2

N. T. Shideler
Pittsburgh Coke & Chemical Company
Pittsburgh, Pennsylvania

Cold Applied Coatings

There are many occasions when it is not economical or feasible to apply hot coatings and a cold applied coating is indicated. There are four main types of cold applied coatings, two of which have been widely used for the protection of underground metallic structures. The four types of cold applied coatings are described to give continuity.

Pitch cutback coating. First of the four coatings is normally known as a "pitch cutback," similar in consistency to a normal paint. It is made from a selected coal tar pitch diluted with coal tar solvent to yield a liquid coating that, when applied by normal brush, spray, or roller covers at the rate of approximately 1½ mils thickness per coat. Because of the thin film resulting from a two-coat application, it is not recommended for underground service.

Mineral filled pitch cutback. The second coating, usually termed a "mineral filled pitch cutback," is the "pitch cutback coating" with the addition of mineral filler. This coating, applied at the rate of 3 to 6 mils per coat, is quite similar to the "narrow-range" enamel when dry. Thus, a two or three coat application gives 6 to 18 mils coating thickness and frequently is used to protect metal in underground service. When dry the coating film is the same as a narrow-range enamel except for thickness. As the coating thickness is less than that of narrow-range enamel, it cannot be expected to last as long as the normal 3/32-in. coating of narrow-range enamel.

Coal digestion heavy bodied coating. The third coating is a solvent cutback of the coal digestion pitch to which is added mineral filler and processed, yielding a highly thixotropic, heavy-bodied coating that when dry has all of the characteristics of normal wide-range enamel.

This coating easily can be applied 8 to 15 mils thick in a single application. Usually it is applied in two coats to an average dry coat thickness of approximately 25 mils. Because the coating when dry is identical to a normal wide-range enamel, its use and characteristics follow closely those of the wide-range enamel. This coating is quite well known in industry and is specified by various government services. It is known as CA-50 as specified by the Bureau of Reclamation in Denver, Colorado, and is specified by the United States Navy Department, Bureau of Yards and Docks, formerly under Specification 34 YB, more recently revised under Specification MIL-C-18480. Specification limits are given in Table 2.

If desired, tar-saturated asbestos felt can be applied over the second coat of the CA-50 to gain added protection against penetration by backfill. The coating has been used widely on sheet piling, as a protection for concrete surfaces, on underground storage tanks, small diameter pipe, for patching mill coated pipe, and for many other uses.

Coal tar dispersion or emulsion. There is a fourth coating that is not recommended for underground service, but is mentioned here in order to complete the four cold applied coatings systems mentioned. This coating is a coal tar dispersion consisting of coal tar pitch, clays, mineral filler, and water. The coating is thick and can be applied to thicknesses of 15 mils in a single coat. It has the unusual characteristic of not alligatoring on atmospheric exposure. Most of the other cold applied coal tar coatings do alligator on sunlight exposure except the mineral filled cutback pitch coating and the 34 YB or CA-50 specification materials, when manufactured by a special process.

Since, when dry, two of the cold applied coatings mentioned are basically the same as the narrow-range enamels and the normal wide-range enamels, respectively, characteristics of the coatings follow very closely those of corresponding hot applied coatings. They have much the same resistances to acids, alkalies, and other corrosive materials. These products, of course, have been on the market for a number of years and are well established in industry.

Coal tar-epoxy ether resin coatings, new development. There have been recent developments of new cold applied coal tar coatings. Of special interest is a new type coating consisting of a combination of coal tar or coal tar pitch, epoxy ether resins, solvents, and mineral fillers. This coating is a thick, heavy-bodied coating similar in thickness to the heavy-bodied 34 YB or CA-50 coating. The new coal tar-epoxy coating is a two component system in which the main body of the coating is mixed on the job with a catalyst, usually some form of amine, then applied to clean metal surfaces by brush, spray, or roller application. The coating sets up slightly by evaporation of the solvent, but complete setting or hardening is by catalytic action or polymerization of the epoxy resins.

The coating is easily applied in thickness up to 15 mils in a single coat application; has very little shrinkage on setting (less than 10 percent), and produces a coating that is quite hard, yet retains considerable flexibility, excellent adhesion

TABLE 2. Department of the Navy Bureau of Yards and Docks Specification 34 YB now MIL-C-18480.

Section 1-05 coal tar base coating	Minimum	Maximum
Distillate by weight		
% to 235 C	20	30
to 150 C		None
Softening point of residue, F	205	240
Penetration of residue at 77 F, 100 g., 5 sec	5	
Ash, by weight:		
Total coating, %	15	25

FIG. 9. Large diameter corrugated steel drainage pipe protected with two coats of filled pitch cutback coating.

FIG. 10. Application of 34YB or CA-50 Type cold coating to bottom section of steel storage tank to protect underground section against corrosion.

to metal, and once completely polymerized is only very slowly attacked when completely immersed in aromatic materials. It is completely immune to all crude petroleum and petroleum products including gasolines, jet fuels, kerosine, etc. It is resistant to acids and alkalies, is not affected by soil stress, and is seldom penetrated by pressure of stones or rough objects resting against the surface of the coating.

Another unique feature is its complete resistance to all types of normal immersion either in fresh or salt water. It is only slightly affected by growth of barnacles on the surfaces of the coating, and it becomes harder when exposed to higher temperatures.

Tests thus far indicate that it may be used safely on underground structures that are at a constant high temperature of 300 F. It has been used on small pipeline, on oilostatic cable lines, structural steel, as a lining for crude oil storage tanks, and for the coating of underground metallic structures in chemical plants where it is used because of its widespread chemical resistance.

Table 3 gives a typical specification for a standard coal tar-epoxy coating.

Fig. 11, 12, 13, 14 and 15 show typical applications of coal tar-epoxy coating to structures mainly for underground service.

Summary

In the design of an underground structure, conditions that must be considered in the selection of the coating are normally known. The same is true of an underground structure that may have to be uncovered, cleaned, and coated to increase the life of the structure. The conditions to look for are:

1. Maximum in-service temperature (temperature of product and pipe) to which the structure will be subjected.
2. Condition of the soil around the structure.
3. Possibility of high saturation of the soil by contaminants such as petroleum, acids, alkalies, or aromatic chemicals.
4. Atmospheric temperature to be expected at the time of application of the coating and subsequent remaining aboveground in the atmosphere prior to lowering-in and backfilling.
5. Types of immersion — fresh water, salt water — such as river crossings, offshore work, and swampy areas.
6. Possibility of high soil stress.

Service temperature, soil stress, and type of backfill must be considered in the selection of the coating. If the buried structure is in a normal soil that does not exert excessive stress and is not loaded with rocks and various objects that may cut through the coating, then the hot applied coating corresponding to the maximum in-service temperature can be selected. Either of the two normal cold applied coatings also may be selected in cases where the hot applied coating is not economical for application.

If the soil exerts high soil stress and has a rocky backfill, it would be wise, when the temperature of the structure-in-service is above 110 F, to select the hot pipeline enamel because of this enamel's resistance to stresses, high tempera-

TABLE 3. Typical specification for coal tar-epoxy resin coating.

	Minimum	Maximum
Component A		
Specific gravity, 25 C	1.22	1.28
Weight per gal, lb	10.16	10.66
Volatile, distillate to 235 C, ASTM D20; % by wt	20	25
Total solids, % by wt	75	80
Pigments, mineral fillers, % by weight of total solids (by ash determination)	23	28
Viscosity, Brabender, heavy spring, wide paddle	200	300
Component B		
Amine catalyst, 6 oz per gal of Component A		
After mixing and catalyzing		
Sag test: 15-mil coating thickness applied to vertical steel plates 1/8" x 12" x 12"		No curtaining or sag at 77 F
Set time, Firm Dry Film 15-mil coating thickness as applied to steel plate above, at 77 F		24 hr max

FIG. 11. Sheet piling coated with two coats of coal tar-epoxy resin. Driving of piling did not damage coating.

FIG. 12. Application of two coats of coal tar-epoxy resin coating to hull of tow boat in salt water service.

FIG. 13. Application of two coats of coal tar-epoxy resin coating to fittings for gas transportation line.

FIG. 14. Hand application of coal tar-epoxy resin coating to small diameter pipeline.

Conclusion: Selection is simple

ture, etc. If the same condition exists and the temperature rises much above 160 F, it would be wise, where possible, to utilize the new coal tar-epoxy coating, which becomes harder with higher temperature, has no cold flow, and can withstand high temperatures without being ruptured by stones or objects in the backfill.

The question of acids or alkalies as contaminants in the soil can be completely discounted in the use of the coal tar coatings because the concentration of such materials could not be high enough in the soil to damage the coating. Thus, any of the hot applied or cold applied coatings will withstand these conditions.

With regard to contamination of soil by petroleum or petroleum products where the in-service temperature is not above 110 F, narrow-range enamel is excellent. If the temperatures are higher than 110 F, then hot pipeline enamel would be the recommended coating.

Underground structures in and around chemical plants or petroleum plants where the soils around the structure may be heavily contaminated with petroleum or a wide range of chemicals including aromatic chemicals, the wisest selection for this service would be the new coal tar-epoxy resin coatings. This coating also would be desirable where the temperature of the underground structure is above 180 F but not above 300 F.

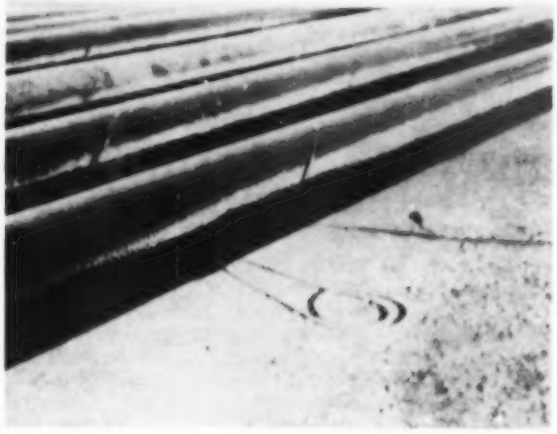


FIG. 15. 10.75-in. diam oil well casing coated with two coats of coal tar-epoxy resin coating before installation.

In fresh water — either in river crossings, lake beds, or swampy areas continuously wet — any of the coal tar enamels are satisfactory. In the case of river crossings, it is more a selection of a *coating system* rather than the specific type of coal tar enamel. For instance, in a fast moving stream with the pipe not too well covered by backfill, it is wise to use thicker coatings of enamel with the use of glass mat pulled into the coating plus the use of an outside wrapper of coal-tar saturated asbestos felt to help protect the coating against erosion.

In salt water, the main difficulty primarily is the cutting of coatings by the calcareous shell of barnacles. On coated structures in salt water where barnacles are prevalent, it is wise to protect the coating with some material that has a harder surface than the shell of the barnacle, such as a continuous coating of concrete over the coal tar coating or burial of the structure below the mud line.

Although this discussion appears to show a complicated selection process, it is not so serious as may be indicated. Basically, it is simply setting down a table of conditions to be met and then selecting the coating that has the characteristics to combat the conditions and give lasting protection under the known conditions. ★ ★ ★

New executive members of Pipe Line Contractors' Association of Canada are shown here. Seated, left to right: Ron K. Banister, past president; C. A. (Cal) Callahan, president; George A. Wilkinson, treasurer and past president. Standing, left to right: R. George Murray, Jr., director; Robert Thomas, director; Gordon W. Walker, first vice president; E. A. (Jake) Hooper, second vice president, and A. O. (Ack) Ackroyd, executive secretary.
—*Photo by Bill Halkett, Victoria, B. C.*

What the CANADIAN CONTRACTORS Talked About

. . . At Their Annual Meeting

Leslie Orr Rowland

WHAT'S ON THE MIND of Canadian Pipe Line Contractors? Turns out they're thinking about safety on the job for the present and the effect of atomic energy on pipeline construction in the future.

Meeting in Victoria, British Columbia, from February 19 to 22, they heard an encouraging report on 1957 from President Ron K. Banister, approved a comprehensive safety manual that marks a milestone in committee work, received a standard equipment rental rates manual prepared by another committee, listened to an illustrated technical discussion on equipment replacement intervals, and heard a paper on the economic and social impact of pipeline construction and operation on a typical Canadian province.

Substantial aid for the petroleum industry from development of nuclear power was forecast by General James R. Doolittle, vice president of Shell Oil Company, in a feature address.

Nuclear energy, said the famous general, will be used principally as a source of or replacement for electrical power. It will be relatively slow in Canada, where 90 percent of power is generated by water flow at no fuel cost. Eventually, as costs can be reduced, it will become the principal fuel for large stationary power plants, gradually replacing residual petroleum fuels.

This development will release petroleum products for more effective use in the rapidly growing petrochemical field and as fuel for heating and for small prime movers. Meanwhile, the general explained, more modern refinery equipment and techniques will permit economical cracking of heavy fractions to more valuable light ends, which cannot be replaced so easily. Actually, he said, it is likely that petroleum will be hard pressed to meet all the demands on it in the enormously increasing energy market. At the same time, improved recovery methods in the future should result in raising ultimate recovery ratios from 30 to 60 percent or better.

The two-thirds of United States total energy requirements now supplied by petroleum will increase to a higher proportion in the next decade at least, the general thought, indicating a sizable expansion of oil industry capacity and of the pipeline structure. Nuclear power, applied in the most efficient channels, will help to defer the time when petroleum supply is no longer able to keep up with its most efficient and economical uses.

The general deplored the intrusion of emotion into public affairs, speaking at an informal press conference before his address. He illustrated the bad effects of this element with two examples: The failure of the natural gas bill in congress due to over-promotion, and the improper and exaggerated presentation of the Canadian complaint about the United States oil import quota which ignored the fact that there was no immediate or near-term hardship.

At the same time he was critical of

United States producers and refiners who failed to recognize the transitory nature of the emergency demand created by the Suez Canal closure. They built up stocks, he said, which were far above the necessary surplus required for national security, and are suffering now as a result.

The essential collaboration between petroleum and nuclear power was emphasized by Dr. William M. Campbell, Atomic Energy of Canada, Ltd., who outlined the Canadian approach to nuclear power development. He pointed out that by 1975 a condition of fuel famine through rising prices will be felt unless nuclear energy is introduced to share the demand load. The ideal but unattainable solution, he said, would be to save all the versatile fossil fuels for mobile transport (largely supplied by pipelines in Canada), and for petrochemical manufacture, leaving the less versatile nuclear fuels for central station power plants. By 1968, he estimated, nuclear power should be down to a level with coal for cost, and the establishment of large stationary generating plants powered by nuclear fuel should be underway in the first instance in southern Ontario.

Gene Evancoe, Canadian special representative of Caterpillar Americas Company, presented a brand-new statistical method of calculating equipment replacement schedules on the most economical time basis. Using detailed charts of normal working hours over various periods of time, the Metre Method (most economical time to replace equipment) includes the four points that are thought to be of the greatest importance in determining replacement intervals.

These four points are: (1) Major repair and overhaul costs; (2) productivity; (3) availability (conditioned by lost time as equipment ages), and (4) capital value decline through depreciation.

The safety manual, presented by a committee which worked throughout 1957 to develop a guide to cover all conceivable situations in construction practice, met with immediate acceptance. Full consultation with the provincial workman's compensation boards in all provinces was carried on, and the committee expressed the hope that faithful application of the principles of the manual will help to bring compensation rates down to the low level enjoyed by many other major industries.

A foreword to the manual emphasizes the responsibility of management and supervisory personnel to lead the way in safety rule enforcement.

"The hazardous nature of the industry requires the thoughtful attention of skilled supervisory personnel to insist upon safe and proper methods being adopted by each new employee," it says. The manual has been compiled to fulfill one of the prime purposes set out in the association by-laws: "To eliminate as far as possible the occurrence of injury and death to pipeline contracting employees."

The equipment rental guide is a new manual designed to set up realistic schedules of statistically sound rates. It was prepared in a simple form that lends itself to alteration as required. The principal bases for its structure are the two problems of how to calculate replacement value of all equipment and how to calculate depreciation on automotive equipment. President Banister pointed out that it is not intended to have any mandatory authority and that it is flexible enough to be adapted to local geographical conditions and working conditions.

A thoroughly satisfactory advance in the qualification of Canadian workers during 1957 was reported by President Ron K. Banister, Fulton-Banister, Ltd., Edmonton. On more than 25 spreads working in Canada last year, every unskilled and semi-skilled hand was a Canadian. Further, 70 percent of all welders and 90 percent of operators were Canadians, whom contractors had trained on the job or through sponsored schools. The objective, Banister proclaimed, is 100 percent Canadians in the latter two categories.

The coming year, the president declared, will at least match the record-breaking and tremendous 1957 construction season for total mileage, but after 1958 the prospect is less encouraging. He deplored the failure of governments to take action on gas export policy, which may delay the start of construction on further big-inch gas lines for as much as two years after completion of the only remaining major project this year. He called attention to the possibility of severely restricted crude oil sales if difficulties develop in finding wider export markets.

In holding off gas export when it is being asked for by potential customers, Banister continued, we may be missing an opportunity to sell a product which may not always be as marketable as it is now. In the case of oil, if the logical markets now being exploited in the northern states and on the west coast are denied to Canada for other than economic reasons, he suggested it would be necessary to consider resorting even to uneconomic means to extend the domestic market to Montreal, now served by imported crude. In closing he urged the industry itself to make every effort to extend its own markets for both oil and gas regardless of the lagging of government policy.

Discussing the enormous economic transformation wrought by oil and gas discoveries and pipeline development in Saskatchewan, Honorable Russell Brown, minister in charge of Saskatchewan Power Corporation, described the meteoric growth of the natural gas distribution system in six years to 574 miles of main transmission lines and 100 miles of field gathering systems. More than 300 miles will be added this year, he said.

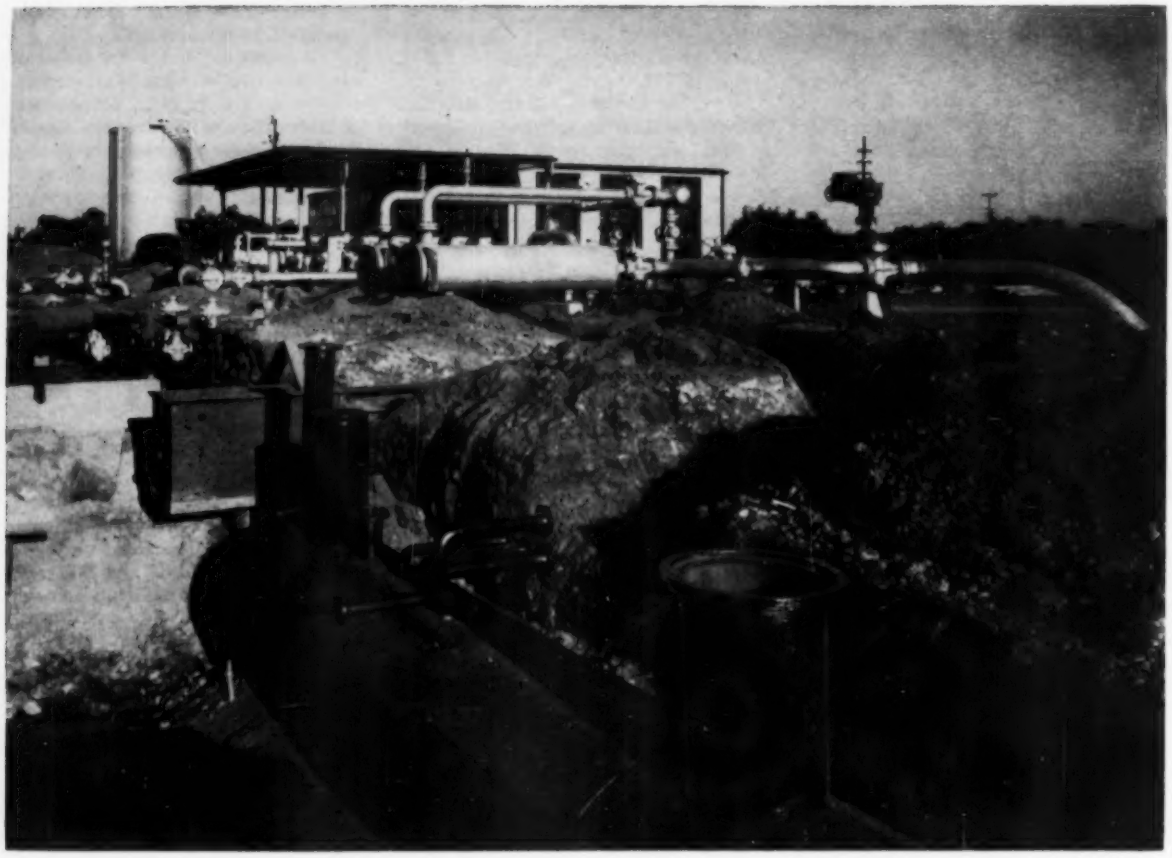
Petroleum has become Saskatchewan's second most important single harvest after wheat, Brown asserted, and pipelines provided the arteries that made the crude oil and gas of value by moving them to economic markets.

Since 1950, he pointed out, 90,000,000 bbl of oil, worth $140,000,000, have been transported from the province by pipeline. In the last five years, illustrating the economic benefits of pipeline operations, $140,000,000 has been invested in pipelines alone, while $500,000,000 has been invested in the entire petroleum industry. Some 6000 new jobs have been created by this activity.

Membership in the association has increased to 38 regular (contractor) members and 61 associate members, reported Executive Secretary A. O. Ackroyd.

Concluding the session, the election of officers resulted in the installation of C. A. (Cal) Callahan as president. Callahan, vice president of Majestic Contractors, Ltd., Toronto, is a graduate of University of Kansas with the degree of bachelor of science in civil engineering. He came to Canada first in 1951, on an assignment with Williams Brothers, which was to last "a week or 10 days" and has stretched out to seven years.

Gordon W. Walker of Calgary, manager of the Mannix Company, Ltd., pipeline division, was elected first vice president, while E. A. (Jake) Hooper, general manager of F. E. Shaw, Ltd., Sarnia, became second vice president. George A. Wilkinson, executive vice president of Marwell Construction Company, Ltd., Vancouver, a past president of the association, was re-elected treasurer. Directors elected were: R. George Murray, Jr., executive vice president, Dutton-Williams Brothers, Ltd., Calgary; past president Ron K. Banister, president of Fulton-Banister, Ltd., Edmonton; Robert Thomas, president of Canadian River Construction Ltd., Fort Worth and Vancouver, and A. O. (Ack) Ackroyd, practicing attorney in Edmonton, executive secretary. ★ ★ ★



Considerable underground station piping, sump tanks, and main line valve and scraper trap risers, along Plantation Pipe Line Company's new 18-inch line from Baton Rouge, Louisiana, to Helena, Alabama, were coated with Roskote A-51 for corrosion protection—chosen for its resistance to accidental exposure to petroleum products.

ROSKOTE MASTIC A-51 fully protects your underground metal even if exposed to petroleum products

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Pipeline Fundamentals

PIPELINE WELDING

Part I. Background

Richard D. Morel
Senior Welding Engineer
Transcontinental Gas Pipe Line Corporation
Houston, Texas

WELDING is the most important skill in the pipeline industry. Regardless of the quality of the pipe, the valves and the fittings that go into a pipeline, the system is only as good as its poorest weld.

Yet despite its importance, welding is probably the least understood skill in the industry. And no wonder. It is a complex process involving a number of sciences and a myriad of variables. A qualified welder must be a man with exceptional co-ordination and muscle memory who can automatically cope with these many variables inherent in field conditions. In making a single pass, he must successfully compensate imperfection in line-up, bevel, roundness of pipe, etc. Surprisingly the welders themselves are often unaware of the intricacies involved in making a weld.

Although many general articles have been written on welding, few of them attempt to answer questions on the practical aspects of pipeline field welding.

Just how is a weld made? What takes place in the arc? What functions do the electrodes perform and what functions do the welders perform? How does bevel, spacing, cleaning, alignment, etc., affect the quality of a weld? Moreover, how is the quality of a weld determined, controlled, etc.?

FUNDAMENTALS OF WELDING

Let's first take a look at the basic welding process on the pipeline. Field welding of pipelines today is accomplished almost exclusively by means of the shielded metallic arc process. It employs a d-c generator and coated electrodes or welding rod.

Electrodes

The coating on an electrode performs many functions. The more important are to shield the arc, form slag to cover the molten metal during cooling and solidification and to stabilize the arc. Certain types of coatings may also contribute to alloying of the weld metal. The protection afforded by the gases and slag formed during welding serves to prevent undesirable reactions between the molten metal and gases present in the atmosphere. Oxygen and nitrogen can combine with molten steel to form undesirable oxides and nitrides, to greatly lower the mechanical properties of the weld. A comparison of the properties of weld deposit of a mild steel coated electrode and an uncoated electrode illustrate this point.

	Tensile	Elongation
Uncoated	45,000 - 55,000	5-10% in 2 inches
Coated	62,000 - 70,000	22-25% in 2 inches

Welding Arc

The welding arc has several functions. First it provides temperatures in the order of 6000 deg C to melt the base metal of the pipe and the filler metal in the electrode. At the some time it provides a path for the droplets of filler metal that must be transferred to the weld.

Variables

In order to show clearly the degree of skill required of the welder to produce a pipe weld, it will be useful to discuss the relationships of the many variables that must be controlled by the welder.

The welding machine voltage and current settings are probably the prime variables that the welder has to deal with. For any given machine setting, variations from these two settings depend mainly on the motions the welder imparts to the electrode while welding.

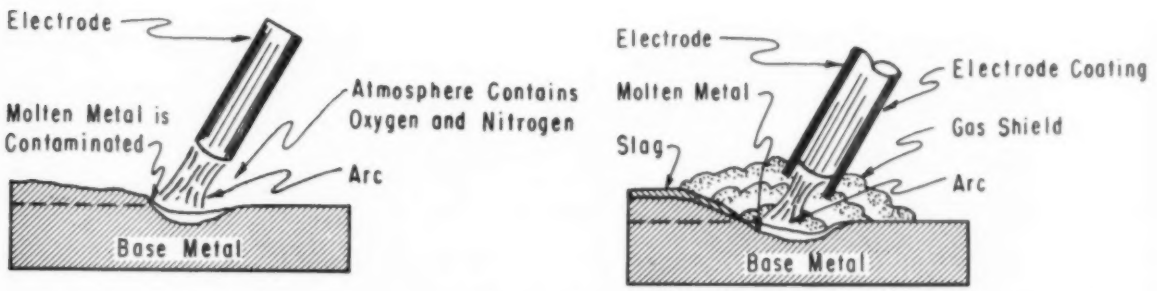

FIG. 1. The coating on an electrode performs many functions, the most important being to shield the arc, form slag to cover the molten metal during cooling and solidification, and to stabilize the arc.

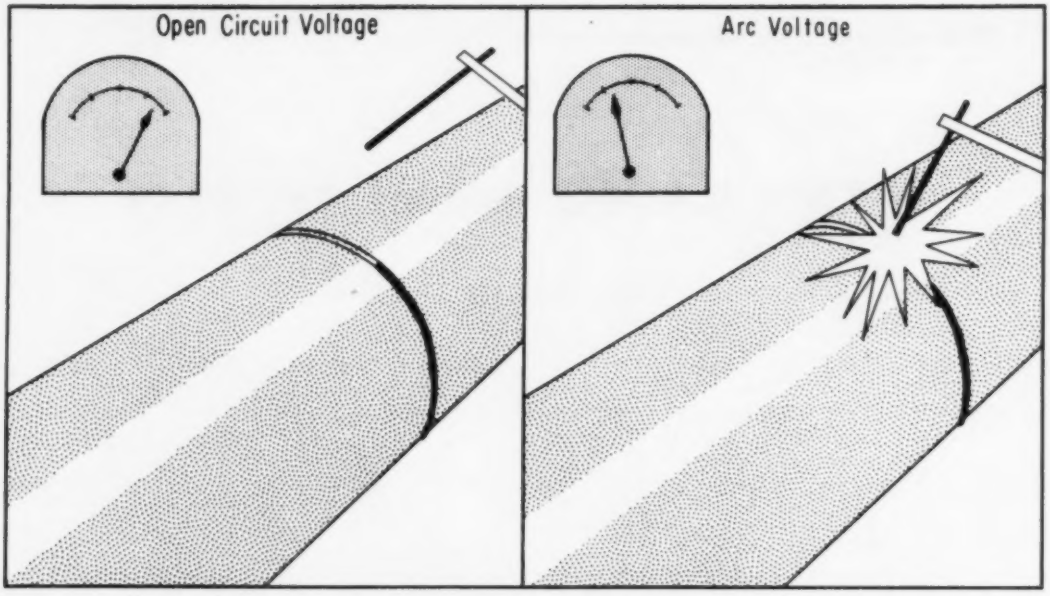

FIG. 2. Basic welding circuits have two types of welding voltages: (1) Open circuit voltage, and (2) arc voltage.

Basic welding circuits have two types of welding voltages. They are: Open circuit voltage and arc voltage.

Open circuit voltage is the voltage available to the terminals of the welding generator or between the electrode and the pipe when no welding is being done. It is determined by the voltage setting on the welding machine.

Arc voltage is the potential between the electrode and the pipe or across the arc when welding is being done. Open circuit voltage drops to arc voltage when the arc is burning.

Open circuit voltages are usually set between 50 and 100 volts while arc voltages vary from 18 to 36 volts. The value of the arc voltage varies directly with the arc length. If the arc length is increased the arc voltage increases; if the arc length is decreased the arc voltage decreases. Most welding machines have controls for setting open circuit voltage and welding current. For any given open circuit voltage setting the welding current available is determined by the setting of the current control.

The relationship of open circuit and arc voltage and current is plotted as shown on Fig. 4 and 5. We can see from these figures that low open circuit voltage settings give relatively flat volt-amp curves and high open circuit voltage

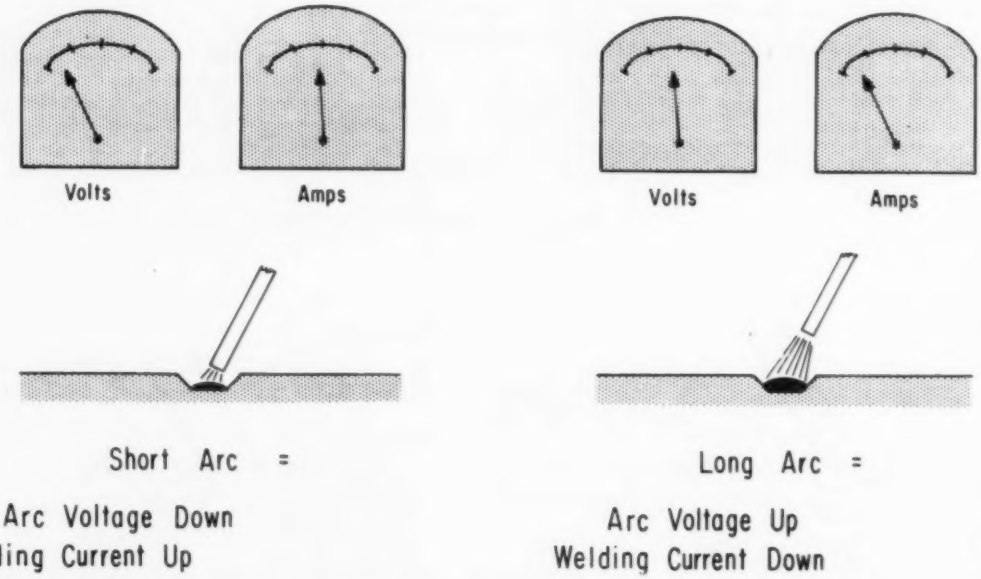

FIG. 3. The value of the arc voltage varies directly with arc length. If the arc length is increased the arc voltage increases; if the arc length is decreased the arc voltage decreases.

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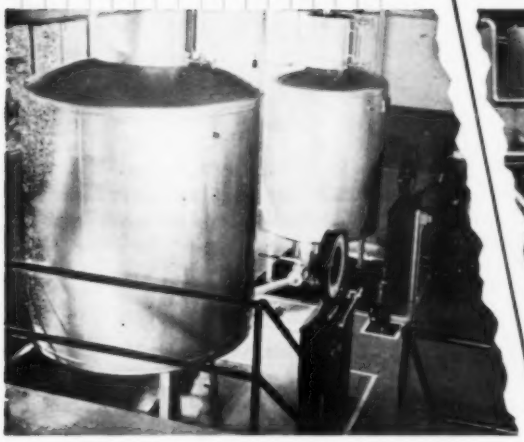

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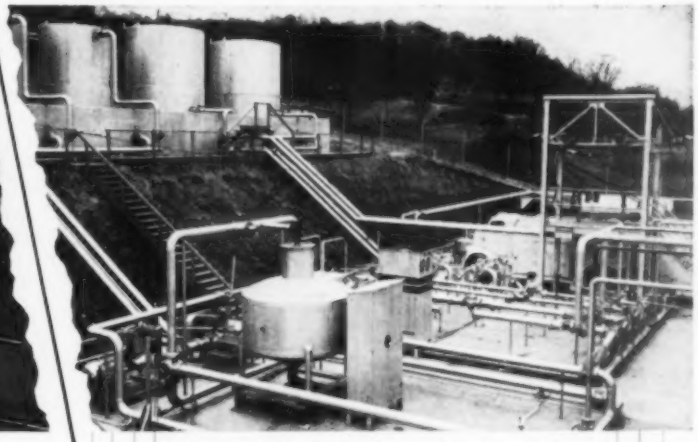

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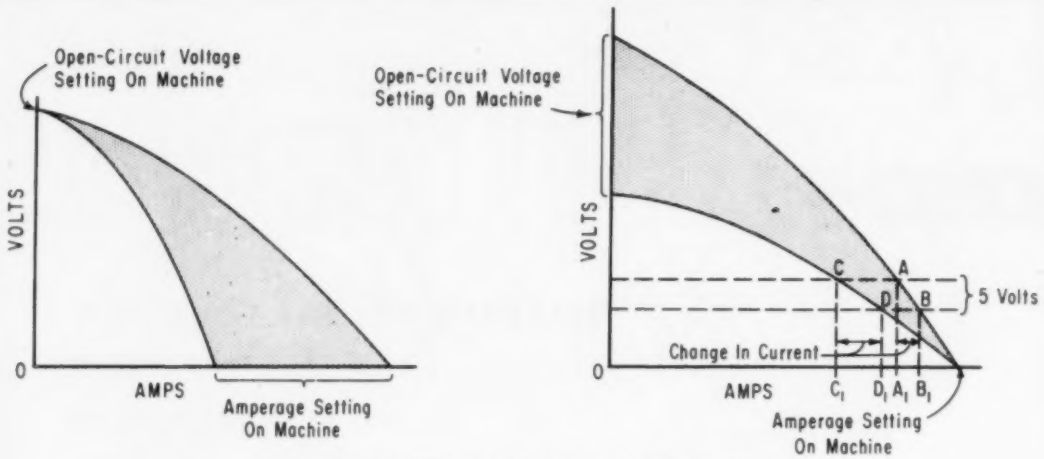

FIG. 4 (left) and FIG. 5 (right) illustrate the relationship of open circuit and arc voltage and current.

settings give relatively steep volt-amp curves. We can also see that welding current varies with arc voltage and arc length. For example, shortening the arc length so as to decrease the arc voltage and move from A to B (25-20 volts) on Curve 1 in Fig. 5, increases the welding current by an amount equal to increment A_1 B_1. Moving from C to D on Curve 2 in Fig. 5 (25-20 volts) gives a larger increment increase in welding current equal to C_1 D_1. Thus for any given current setting the lower the open circuit voltage setting the larger the change in welding current for any given change in arc voltage or arc length.

Effect of Open Circuit Voltage Settings

Although open circuit voltage has very little effect on arc voltage, open circuit voltage does have an effect on the arc characteristics. Higher open circuit voltages tend to produce a more forceful spraying type of arc. The penetrating ability of the arc is determined primarily by the welding current and varies directly with it. The burn off rate of an electrode is almost linearly proportional to the welding current, with higher currents thus allowing higher welding speeds. However, to achieve a sound weld with desired penetration and desired surface shape and appearance, the welder is required to control all of these variables with a high degree of skill.

We have seen the basic relationships of open circuit voltage, arc voltage and welding current and also how these variables are controlled by machine settings and by variation of arc length due to manipulation of the electrode. We shall now show what association the direction or position of welding has to these variables.

Welding Positions

There are four basic welding positions — flat, horizontal, vertical, and overhead. In the flat, horizontal, and overhead positions, the direction of travel has no significant effect on the manipulation required of the electrode. But in the vertical position, the direction of travel is an important variable, and is usually specified in the welding procedure.

PIPE WELDING — COMBINATION OF POSITIONS

Since pipe welding is a combination of all possible positions, it will be easier to the influence of each position on the welding process by considering them individually.

The available positions and directions of welding are shown in Fig. 6. Each direction requires a different arc characteristic, different current, and electrode manipulation.

In the flat position, welding does not require the variation in current that comes from changing the arc length or moving the electrode in and out of the crater. Actually, it is usually desirable to minimize such changes in current in the flat position. Therefore, a fairly high open circuit voltage setting would be used giving a relatively steep volt-amp curve, so that unintentional changes in arc length would not cause significant changes in welding current.

Uphill Welds

When welding in the overhead, vertical up (or uphill) or

The Author

Richard D. Morel, senior welding engineer, Transcontinental Gas Pipe Line Corporation of Houston, Texas, started in the pipeline business shortly after graduating from Massachusetts Institute of Technology in mechanical engineering in 1949. His first job was with Fish Engineering as a construction engineer on the Transco system, then under construction. He transferred to Transco in 1951 and served as an engineer in the measurement department until 1954 when he obtained his present position. He is a native of Hudson, Massachusetts, and served in the U. S. Navy in World War II in the Pacific area.

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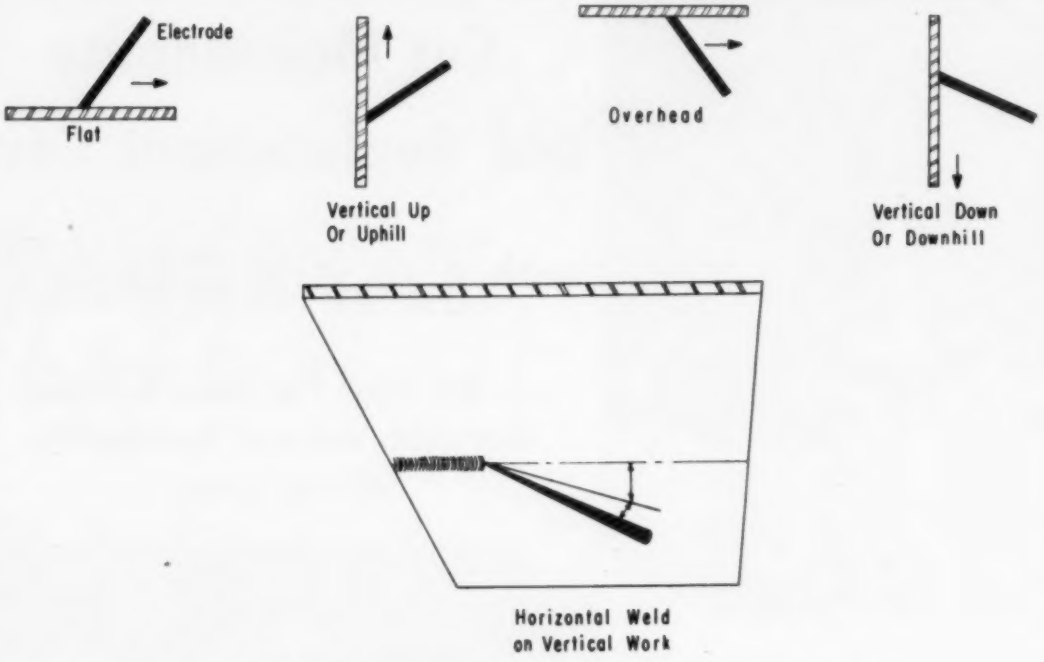

FIG. 6. These are the available positions and directions of welding. Each direction requires a different arc characteristic, different current, and electrode manipulation.

horizontal direction, it is desirable to be able to increase and decrease the welding current rapidly and almost continuously. The welder does this by using a low open circuit voltage, giving a relatively flat volt amp curve. Thus, by moving the electrode into the crater the welder is able to shorten the arc length, increasing the welding current and deposition rate, and thereby achieve good penetration. Now by moving the electrode out of the crater, and increasing the arc length the welder decreases the welding current and deposition rate allowing the previously deposited metal to cool sufficiently to "freeze." If the welder did not move the electrode away from the crater at intervals the heat input would be high enough to prevent fast enough freezing and molten metal would run out or fall out of the crater. Manipulation of the electrode into and out of the crater must be continuous and skillful motion performed by the welder.

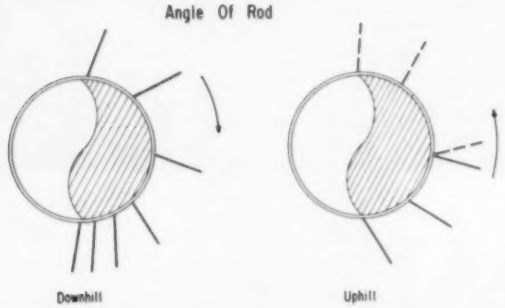

FIG. 7. Welding downhill requires higher voltage and current settings than the uphill and overhead positions.

Downhill Weld

Welding vertically down (or downhill) requires higher voltage and current settings than the uphill and overhead positions. When welding in this direction, the force of the arc helps to prevent the molten metal from running out of the crater. This is accomplished again by skillful manipulation of the electrode by the welder. In addition to controlling arc length welding current and other related variables by proper movement of the electrode, the welder must also maintain an angle between the electrode and the work that will deposit filler metal in the proper place, produce the required penetration, and provide the proper contour to the surface of the deposit.

All of these things must be controlled simultaneously by the welder and they require a slightly different manipulation for each position of welding. The position welding of pipe is a process that in proceeding from top to bottom, (downhill) or from bottom to top (uphill) we encounter an infinite number of different positions between flat, vertical, and overhead. As the welder proceeds around the circumference of the pipe, he is called upon to continuously adapt his technique to the continuously changing positions that he is encountering. This is one of the reasons that pipe welding requires such a great deal of experience and skill.

The discussion presented in the preceding paragraphs applies generally to the manual shielded metallic arc welding process.

Note: References will be given at the end of this series. Part 2 will appear in the May issue of *The Pipeline Engineer*.

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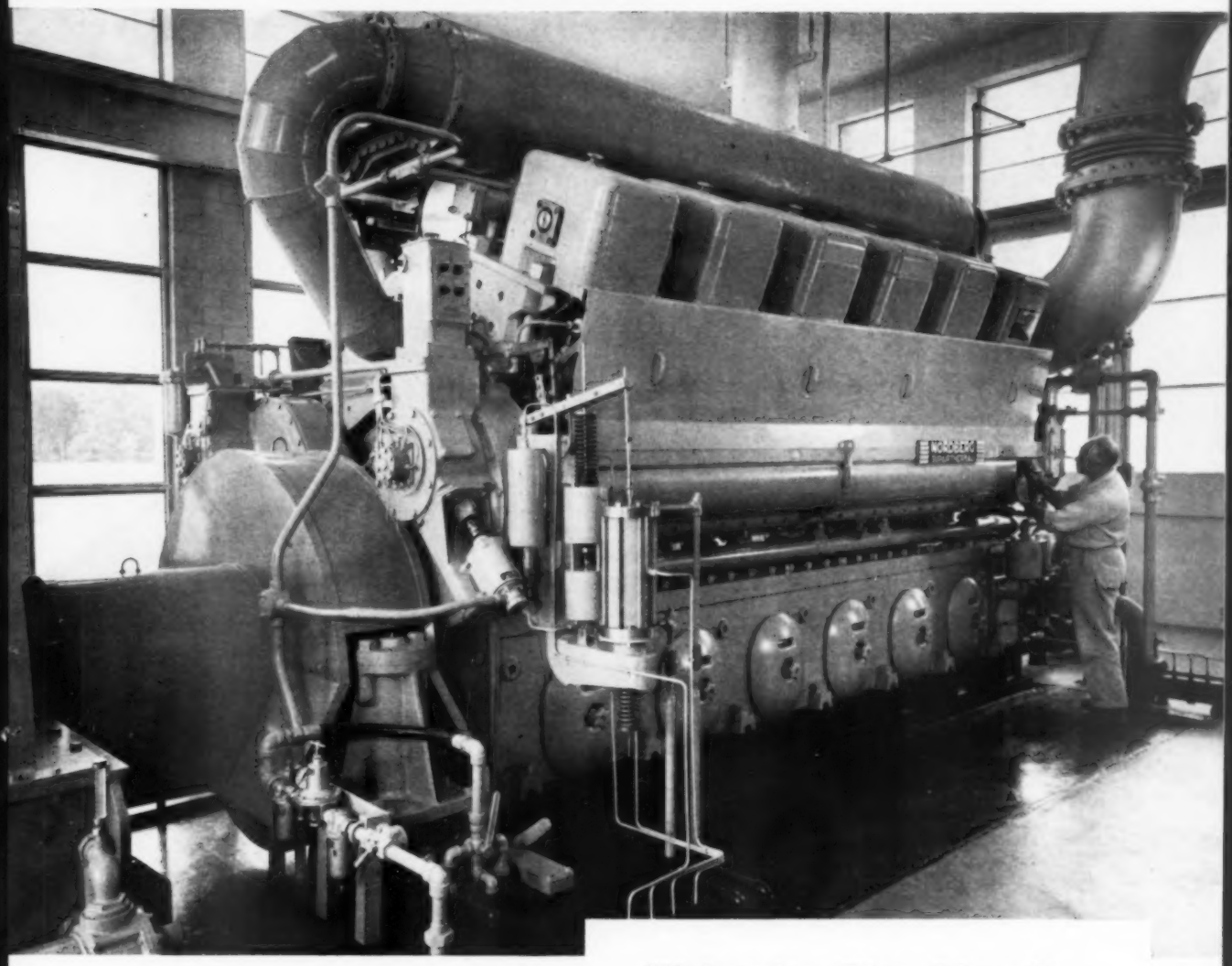

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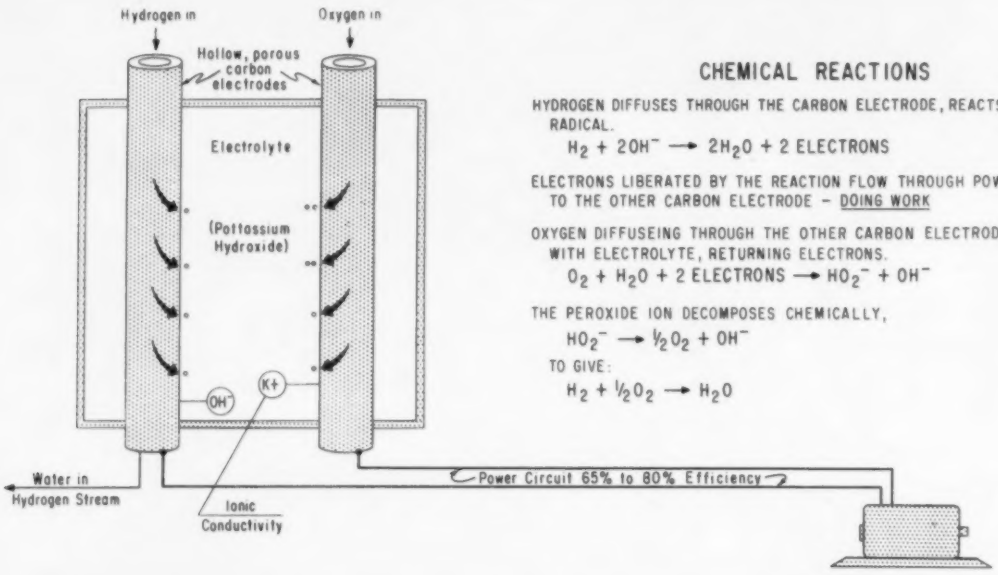
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THE CONCEPT of a fuel cell that could be used to convert the cheap chemical energy of gases into electricity has been a scientific dream for over a century. Now National Carbon Company has announced development of such a cell which is capable of producing thousands of watts of power economically by ionization of hydrogen and oxygen in a plastic, compact unit.

Not only have such cells been operating eight hours daily, five days a week for over a year in the company's Parma, Ohio, research laboratories without signs of deterioration, the U. S. Army has uncovered the world's smallest mobile radar set — "The Silent Sentry" — powered silently by a series of the cells.

While not the first fuel cell, the National Carbon version is the first one that doesn't depend on high pressures and temperatures for operation. Designed to work at ambient temperatures (120 to 140 F) and approximately atmospheric pressures, the new fuel cell eliminates the need for costly and bulky auxiliary equipment and heavy pressure vessels. Devoid of moving parts and containing no exhaustible components, the cell's electrolyte is not depleted by normal operation and requires little or no maintenance. Contrast this with the primary battery (such as in the flashlight) which produces electrical energy by the consumption of its own chemical elements until dead, or the secondary (auto) battery which can be recharged only by passing electricity back into it, and you glimpse the revolutionary nature of the fuel cell.

While no fuel cell is 100 percent efficient — some of the energy produced is wasted as heat — another advantage of the new cell can be seen when it is compared to a conventional steam system in which the heat is supplied by burning gases. Failure to utilize all of the heat produced reduces the overall efficiency of a steam system to approximately 30 to 35 percent, while **the fuel cell, which eliminates the intermediate heat step and converts directly from chemical to electrical energy, has a top efficiency of about twice that figure, utilizing, at normal temperatures, 65 to 80 percent of the energy available in the hydrogen-oxygen fuel.**

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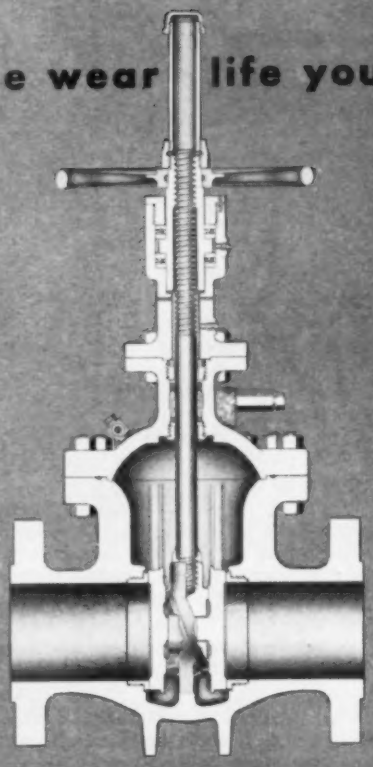

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gases at these electrodes produces an electrical current with water as the sole by-product. The life of the fuel cell is theoretically unlimited.

Actually the operating principle is simply water electrolysis in reverse. Electrical energy is produced by oxidation of hydrogen to water, and a current flow is established that can be routed through an external circuit.

How it works: Secret of the new fuel cell's success is the chemically treated, hollow, porous carbon electrodes through which the gases enter and which conduct the electricity produced by the electro-chemical reaction.

In operation, hydrogen diffusing through the negative electrode is ionized by electrochemical reaction with the electrolyte solution of potassium hydroxide and liberates electrons which flow through an external circuit and back to the positive electrode where the electrons are accepted by the ionizing oxygen. Ionic conductivity through the electrolyte completes the electrical circuit; water produced by the reaction is disposed of by evaporation. Voltage across the cell is about one volt. Current capacity is determined by the physical size of the unit. By varying the number and size of the cells many combinations of voltages and currents can be obtained (the army's "Silent Sentry," for example, is powered by cells connected in series to produce 28 volts). Basically, however, the fuel cell is best suited to high-current, low voltage applications.

Versatility. Though low-pressure operation affords obvious advantages for many potential industrial applications, the new fuel cell isn't limited to that range. Electrical output of a given cell varies directly with pressure; should increased output be desired it could be obtained by increasing the operating pressure.

Efficiency is affected by power density — that is, at lower currents, a greater percentage of the chemical energy is converted to electricity energy. Research thus far indicates that the optimum fuel cell design will be one which will produce approximately one kilowatt of power from a packaged unit one cubic foot in volume.

Although pure oxygen is required for high current densities, a unique feature of National Carbon's cell is the ability to operate on impure fuel gases. The new design permits the use of hydrogen of standard commercial purity, or substitution of air in place of oxygen for producing small amounts of power.

Fuel cells have also been considered as a means of recovering energy from stack gas rich in carbon monoxide and water vapor. The waste gases would be reacted catalytically at the electrode surface to yield hydrogen for cell operation and CO_2. Since the latter would carbonate the caustic solution, regeneration of the electrolyte would be required.

Fuel cell uses: An inexpensive source of hydrogen is essential if the fuel cell is to compete with conventional power systems as they are known today. But the discovery of ways to team fuel cells with other devices for harnessing unused energy from other sources could easily change the picture. Two considerations: Utilization of solar energy to decompose water during sunny periods and store it as chemical energy; nuclear reactors are known to decompose water and could therefore be used to produce hydrogen and oxygen for fuel consumption.

The fuel cell is a supplemental source, rather than a substitute for conventional power supplies, and its application to generation of large volume electricity is still ahead. As of now it is impracticable for such use as public utilities; many of its advantages would be cancelled by conversion from low voltage direct current to high voltage alternating current.

However, short of such central-station requirements, the device — compact, light, silent, durable, and not choosy about pressure and temperature conditions —may make an interesting addition to present methods of generating auxiliary power, and its use in specialty applications seems imminent. It is best suited for direct current users who can use electricity right where it is produced.

In Britain the railway industry has had under consideration the use of fuel cells to level out peaks and valleys in daily power demands. During slack periods idle generating capacity would be used to dissociate water into hydrogen and oxygen, which energy would be converted back into electricity at peak demand periods.

Among other potential fuel cell applications in the near future: Military communications systems, mobile power units and stand-by power plants. Both General Motors and Chrysler are known to have engineering groups working on fuel cells with an eye to future use.

Meanwhile Pittsburgh Consolidation Coal is working with another version of the fuel cell, and long under experimental study in Britain has been a cell developed by F. T. Bacon of Cambridge University, using porous nickel in the electrode instead of carbon.

The present cell as developed by National Carbon consists of nine hollow, porous carbon electrodes grouped in a round, plastic housing. A carbon header on each end channels the hydrogen and oxygen bases into the proper electrodes and electrical connections conduct away the power.

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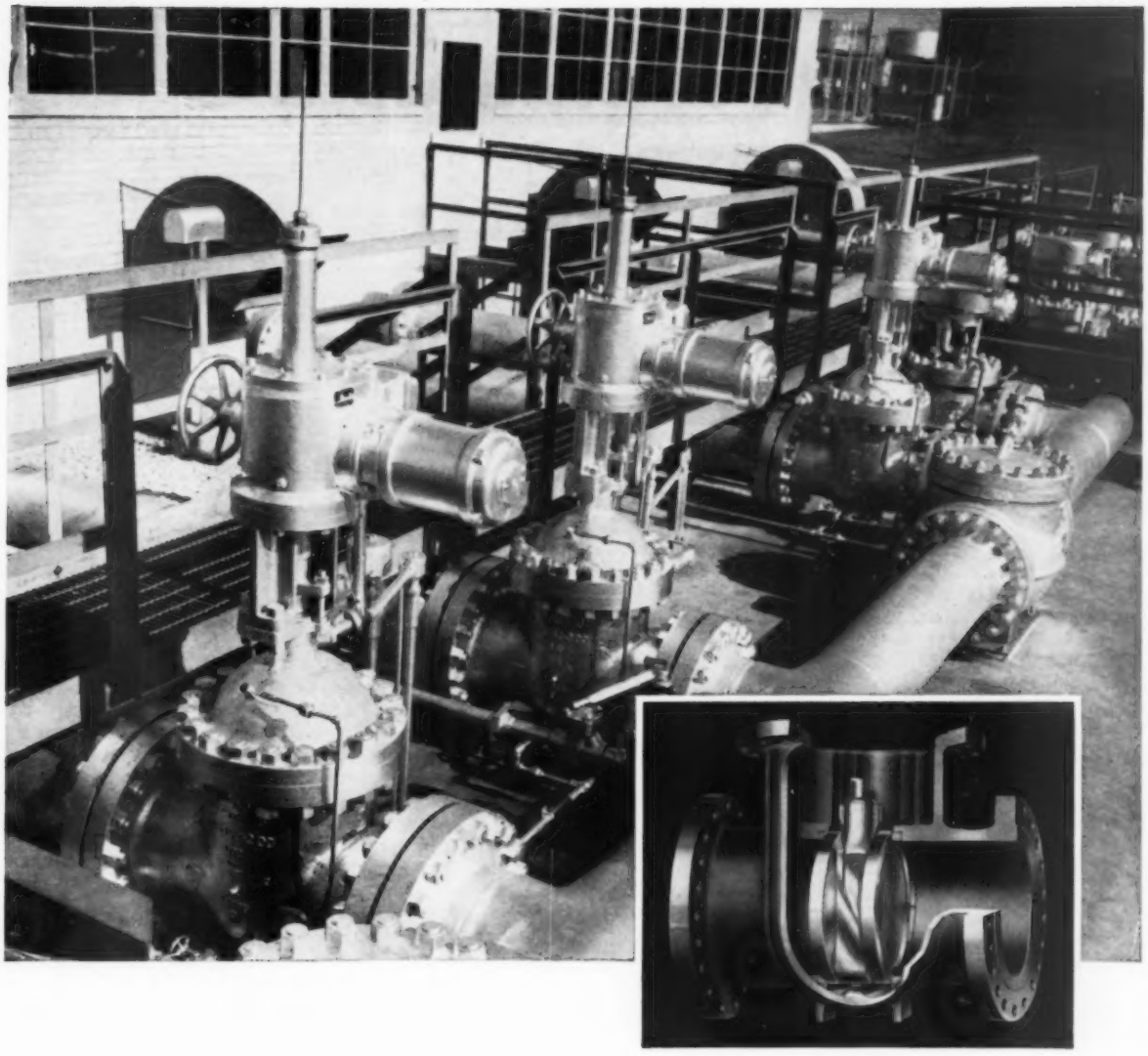

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In one version of the compound arrangement—the free piston gas generator type—the entire net output of the compound power plant is provided by the gas turbine. In another arrangement, the turbine and the reciprocating engine are mechanically connected, both contributing to the total net power output of the compound engine.

In its simplest form (the turbocharged diesel engine) the turbocharger, which in reality is a gas turbine, is free-running and therefore mechanically independent of the engine. It does not deliver any net output, the entire shaft horsepower output of this particular type of compound power plant being delivered by the engine crankshaft.

It is interesting to consider the turbocharger as a gas turbine, and to reflect on the role it plays, as such. Just as is the case with any other gas turbine, one of the most significant variables governing the output and specific fuel consumption of the turbocharger-engine combination is pressure ratio. The higher its pressure ratio, the more important the function of the turbocharger in the overall picture.

The use of higher pressure ratios greatly increases the specific output of the turbocharged engine, improves its specific fuel consumption, and brings about many other advantages. For this reason high-pressure turbocharging has become well established, and the industry is working toward higher and higher pressure ratios. By means of high-pressure turbocharging, the specific output of the atmospheric-aspirated engine has been increased—in the 4-cycle engine from a bmep of 85 psi to as much as 300 psi, and in 2-cycle engines from 65 or 75 psi to 180 psi, and the end is not in sight. Turbocharger pressure ratios of 2.5 to 3 are common today, and substantially higher pressure ratios are likely to be used in the near future. Pressure ratios of this magnitude approach those used in direct-power-yielding gas turbines.

In order to illustrate, numerically, how much the output of an atmospheric-aspirated engine can be increased by turbo-charging and by the use of higher and higher turbocharger pressure ratios, Fig. 1 is presented. For the purpose of plotting the curve shown, an engine is arbitrarily assumed, having a bore and stroke (that is, displacement) and an rpm that in its atmospheric-aspirated version results in an output of 1000 bhp. By turbocharging an engine with the same displacement and the same rpm, the curve shows how much the output increases with increasing turbocharger pressure ratio. It will be noted that with a pressure ratio of 3:1, for example, as much as 3600 hp can be developed. This tremendous increase in output is directly and indirectly due to the effect of the turbocharger and the effect of intercooling between the turbocharger compressor discharge and the engine inlet manifold.

The indirect effect is due to the increased density of the air supplied to the engine turbocharger, which permits the combustion of a larger amount of fuel, hence increasing the engine output. This densifying of the engine combustion air—or, precompression—by the turbocharger, requires a considerable amount of power to drive the turbocharger compressor. The amount of power involved is plotted in Fig. 2, from which it will be noted that for our hypothetical engine (which develops 1000 hp in its atmospheric-aspirated version) the turbocharger turbine must develop more than 1000 hp to permit the compressor to deliver the combustion air to the engine at pressures of 3 atmospheres and higher.

Direct effect that the turbocharger has on increasing the engine output is smaller than that brought about by increasing the pressure and density level of the engine. It is, nevertheless, quite

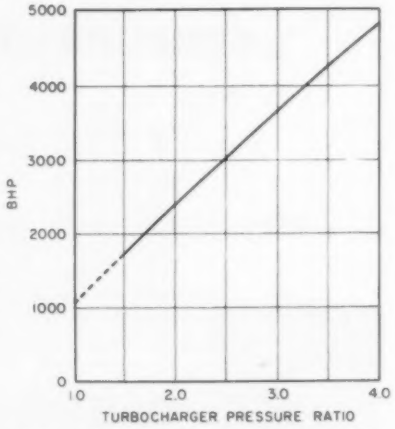

FIG. 1. Effect of turbocharger pressure ratio on the brake horsepower rating of 4-cycle engines having the same rpm and displacement (with intercooling to 100 F).

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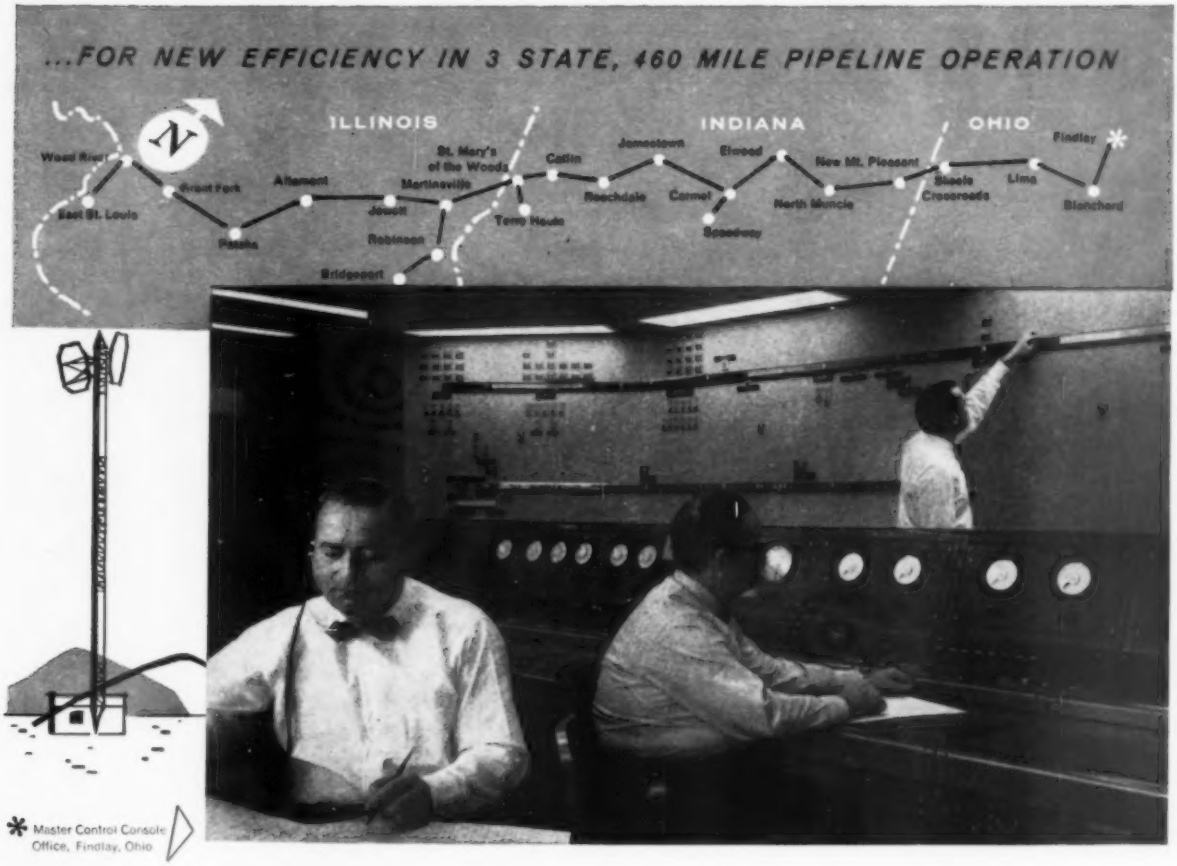

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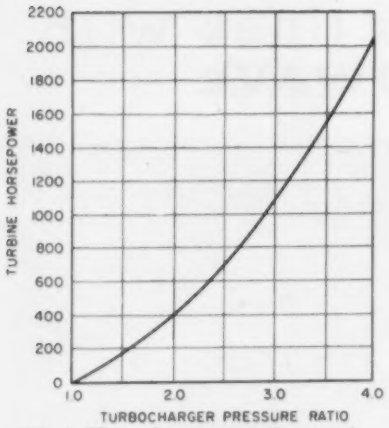


FIG. 2. Effect of pressure ratio on turbocharger turbine output (for a pre-turbine temperature of 1000 F).

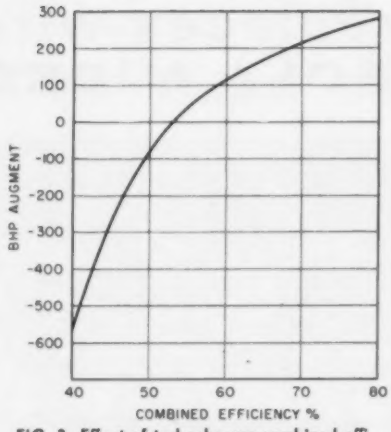


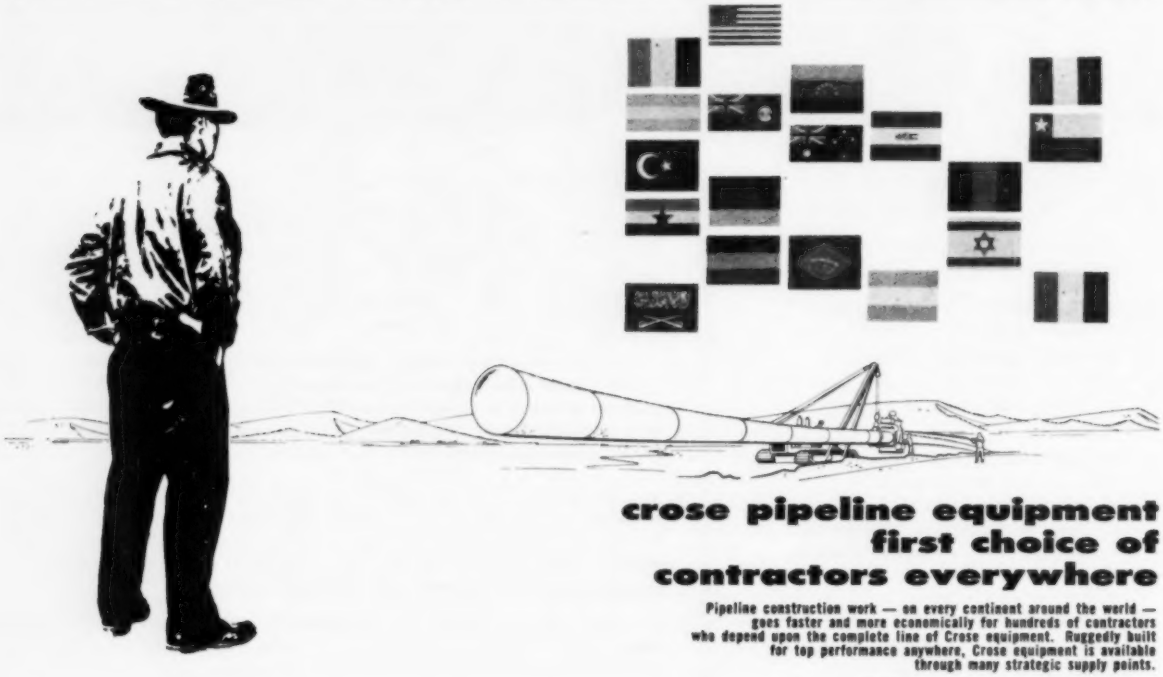
FIG. 3. Effect of turbocharger combined efficiency on turbine output directly utilized by engine (for a compressor pressure ratio of 4:1).

substantial, and is due to the difference between intake manifold pressure and engine exhaust back pressure (pre-turbine pressure), a pressure difference that does two things: (1) It induces flow through the engine, and (2) in the case of a 4-cycle engine it causes the exhaust-suction strokes, which in the atmospheric-aspirated engine are power consuming, to become power strokes. In effect, this pressure difference constitutes the net output of the turbocharger if it is considered as a gas turbine.

Just as is the case in any other gas turbine, the net output of the turbocharger is very sensitive to component efficiencies. If the component efficiencies are low, there is no net output. It may even be necessary to *introduce* power to maintain the gas turbine speed.

Fig. 3 shows the relationship between this net turbocharger output and the turbocharger combined efficiency (that is, compressor efficiency, times turbine efficiency, times mechanical efficiency) for a pressure ratio of 4:1. The net output shown is given in horsepower delivered by the engine, and applies to a turbocharger suitable for the same engine for which Fig. 1 and 2 are plotted. The horsepower outputs shown represent the power the engine develops, during the exhaust-suction strokes of our hypothetical 4-cycle engine, as the direct effect of turbocharging. In other words, this portion of the increased engine horsepower output is heat energy in the engine exhaust gases, converted into mechanical energy, transmitted from the turbocharger to the engine and delivered by the engine crankshaft.

The gas turbine, in the form of a turbocharger, has greatly extended the possible survival expectancy of the reciprocating type engine, to the extent that in all probability the highly-turbocharged reciprocating engine will, throughout the foreseeable future, continue to hold its place in the spectrum of heat power engines. This despite the rapid progress of the power gas turbine, chiefly because the thermal efficiency of the reciprocating engine compounded to a gas turbine (turbocharger) probably will always be substantially higher than that of the pure power gas turbine itself. ★ ★ ★



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What are the prospects of

CANADIAN GAS FOR U.S.?

Excellent! says Federal Power Commissioner William R. Connole

ONE OF THE BAFFLING PARADOXES of our time is the fact that our petroleum wealth is located in some of the most distant parts of the nation and some of the most inaccessible corners of the world. Mankind seems to be engaged in a kind of mass treasure hunt, the rules of which were laid down ages and ages ago.

For example, we need the oil and gas in New York, Boston, Washington, Chicago, and San Francisco, to name but a few of our big markets. We find it in Texas, Louisiana, and Oklahoma. We need oil in Western Europe. We find it in the Middle East, Venezuela, Sumatra, and even in the forbidding wastes of the Sahara Desert. *Getting this oil and gas from where it is found to where it can be used is a true life romance that never ceases to astonish men and to spark their sense of adventure.*

These efforts demonstrate the premise widely recognized by geopoliticians, military men, scientists and virtually all thinking men of our time that the fundamental measure of the extent of the success of modern material civilization is its ability to find and use energy. And fundamental to its success in finding and using energy is its success in mastering transportation problems. Energy and transportation — the two pillars on which our modern material civilization is erected.

The Fossil Fuel Energy Picture

Economists have a way of explaining how an inanimate thing like oil or gas lying unused and unwanted for ages can suddenly become so valuable and so important that whole civilizations will go to war over them. For the purposes of this discussion, however, we need not go into them. The simple fact is that natural gas remained locked in the sedimentary foundations of remote corners of our country and the world until something happened which made it possible and profitable for men to go after it.

What brought this about? First, there was a prodigious increase in the demand for energy and an increasing reliance on fossil fuels for that energy. Second, a means of carrying it cheaply from one place to another was developed.

As recently as 1850, only a century ago, fossil fuels supplied only 5 percent of the world's energy while men and animals were responsible for 94 percent. Today 93 percent of the world's energy is derived from coal, oil, and natural gas. In fact, ⅝ of all the coal, oil and gas consumed since the beginning of the Fossil Fuel Age has been burned up in the last 55 years.

But the appetite for energy is one thing. The means of satisfying it is another. Until men mastered the techniques of transporting oil and natural gas from where it was to where it could be used, that appetite would never be satisfied. To the engineers of our time, the great bulk of credit for this achievement must go. Consider the area in which I am most intimately associated, the natural gas pipelines. Here is a field in which truly staggering progress has been made in less than 20 years. *The Federal Power Commission has certificated nearly 76,000 miles of pipeline in this country alone, able to deliver 70 billion therms of natural gas each year and stretching into every state in the Union with the exception of Vermont and Maine. To the pipelines then must go the credit for transforming a waste product into one of the most valuable energy sources this country enjoys.*

The basic idea of pipelines is the transportation of energy. In our country there is often too much emphasis on the pipelines' function of buying and selling natural gas. Unfortunately, this obscures the fundamental nature of a pipeline. The only reason a pipeline exists is to make natural gas more valuable than it was in the place it was found. In other words, the "utility of location," the traditional contribution of any transportation agency, has been added by the pipeline.

Of course the increase in value must be greater than the cost of moving the gas from here to there. Fortunately, our pipeliners have succeeded in meeting the challenge of keeping that cost below that value, at least within the confines of the United States. But dramatic and intriguing challenges remain.

Natural gas is still landlocked and useless in some of the greatest reservoirs of energy in the world. When the pipeline engineers will solve the problems of getting natural gas out of the Middle East and across Southern Europe into the population centers of Western Europe or down into Africa is a question only time can answer. When South and Central America will begin receiving the blessings of Venezuelan natural gas is also reserved largely for our engineers. Finally, when will the vast reserves of Northwestern and Western Canada be available in this country?

Prospects of Canadian Gas

A look at the pipeline network in the United States superimposed on a map of continental North America is an interesting experience. If the map were a physical map and did not have political boundaries and if at the same time it showed the location of natural gas reserves, we would be struck by the absence of north-south pipelines connecting the Canadian reserves with sizable population centers in this country. The reasons for this absence are simple and well known.

First of all, the existence and extent of these reserves is a very recent discovery. Secondly, the engineering and construction genius which could surmount frightening obstacles like the Canadian Rockies and the terrain north of the Great Lakes are recent developments. But now we have mastered these two problems.

What then are the prospects of connecting the newly discovered reserves to markets in this country?

Personally, I think the prospects are excellent.

As an entirely theoretical matter, I

"The only reason a gas pipeline exists is to make natural gas more valuable than in the place it was found."

From a talk given before the annual convention of the Pipeline Division of the American Society of Civil Engineers, at the Sherman Hotel, Feb. 24, 1958, Chicago, Illinois.

"The commission is directed (by law) to issue a certificate (for importation of gas) until it finds that to do so is contrary to the public interest."

suppose, we could look on all the world's energy as one pool and on all the world's consuming areas as taps drawing on that pool. As a practical common sense matter, however, I know this is no nearer possible than it is to look on the world's entire labor force as one pool and on the world's industries as taps on that pool.

Even on the North American continent practical, realistic, and entirely valid considerations make it extremely difficult to carry out the possible distribution of energy between Canada and the United States on a purely theoretical basis. But, because it is difficult it certainly is not impossible.

The respective national interests of Canada and this country must be observed. They must be respected. They must be given their fair weight in dealing with any attempt to distribute energy between the two countries. We must never lose sight of this fact and we must never belittle it. It is easy to do both, it is easy even to feel a certain measure of frustration when we see how few physical impediments stand in the way of constructing a pipeline network between the two countries.

The first step in achieving mutual respect for each other's best interest is for each to make sure what his own best interests are. Fortunately, both Canada and the United States are in a position to make this determination now. And even more fortunately this determination is being made during the period when construction is being proposed and not after it has become an accomplished fact.

It is entirely fitting and proper for the Canadian Government to undertake the sweeping study which is now being carried out by the Royal Commission on Energy Resources, commonly known as the Borden Commission. As is probably known, this commission was set up with extremely broad and sweeping authority and is charged with the responsibility of making recommendations concerning policies for energy use which will best serve the national interest of Canada. It also will inquire into and make recommendations concerning the extent of authority that might best be conferred on a National Energy Board to administer such aspects of energy policy coming within the jurisdiction of Parliament as may be desirable to entrust to it.

It is entirely proper for that nation to adopt whatever policy best serves its own interest with respect to whether there is surplus gas not needed to bolster its own economy and if so, how and in what quantities should it be exported into this country. I congratulate and commend the Dominion and, indeed, the Provinces for their wisdom and foresight for undertaking this project now.

By the same token, it is entirely fitting and proper for this country to determine its own best interests and to consider the question of utilizing Canadian natural gas on terms which are best devised to encourage and further the best interests of this country.

I said that in my judgment the prospects for pipelines between Canada and this country were excellent. I said that physical and engineering problems had been met. My optimism that the mutual best interest of Canada and the United States will require some utilization of Canadian gas in American markets is the reason why I feel that the only remaining problems will be solved as efficiently and as satisfactorily.

Laws Affecting Importation of Gas

You will be interested in the extent to which there now exists ground rules for the construction of international pipelines between Canada and the United States. You will also be interested in the extent to which construction has been completed following these rules. Only by a knowledge of what we have done so far will it be safe to expect what might happen in the future.

In this country the Natural Gas Act contains a section which gives the Federal Power Commission authority over imports or exports of natural gas. The standard set out in that Section 3 states: "The Commission shall issue (an order authorizing exportation or importation) upon application unless after opportunity for hearing it finds that the proposed exportation or importation will not be consistent with the public interest." Notice that the Congressional mandate is not worded as a prohibition. It is worded affirmatively. The Commission is *directed* to issue a certificate *unless* it finds that to do so is contrary to the public interest. This I interpret as an expression of Congressional intent favorable to the authorization of international pipelines.

The Commission has not had many opportunities of invoking this statute. In fact, there are only four connections presently of any consequence between Canada and the United States. The only existing connections for importation of natural gas are between West Coast Transmission in Canada and Pacific Northwest Pipeline in Washington and, secondly, the connection to serve the plant of Anaconda Copper Company in Montana. Incidentally, this required the enactment of a special law by the legislature of the Province of Alberta. There are only two connections for the exportation of gas from the United States into Canada. These are in Detroit and at Niagara Falls. As a result, expressions of opinion or interpretation of policy are few in this area. Looking at the language of Opinion 271 of the commission in the Pacific Northwest Pipeline Corporation case, as one example, we find this language: "We do not consider it to be in the public interest, however, to authorize a most important new project to serve a major area — involving a large and important new project to serve a major area — involving a large and important segment of the American economy — which from the outset will be completely tied to and wholly dependent upon an exclusive source of supply entirely beyond the control of agencies of the United States." The later Opinion No. 289 in this matter did not materially change this statement.

For another statement of the policy of the Federal Power Commission we have to go "south of the border," so to speak, and read the language written in Opinion No. 296 in the Texas Eastern Transmission case in which authority to import from Mexico was issued. Here the commission said: *"The importation of natural gas from Mexico is clearly not inconsistent with the public interest. All necessary authority to export the natural gas as proposed has been established of record. We view the importation as proposed as indicative of mutual benefit which our country and its neighbor to the South may receive by commercial relations and as illustrative of the mutual faith, confidence and respect each has for the other."*

In addition to the statutory authority contained in Section 3 of the Natural Gas Act there is another source for the jurisdiction of the Federal Power Commission. This control of exports and imports is exercised in an indirect way through the issuance of so-called Presidential permits. Before any export or import of gas may be made, specific authority of the President of the United States is required. By an Executive order dated September 3, 1953, President Eisenhower delegated the authority of the issuance of such permits to the Federal Power Commission.

Unfortunately, perhaps, no standards were transmitted to us at that time by which the Executive Branch

felt governed. Accordingly, the policy of the commission has not been fixed. To date, of course, the lack of such policy has not been important because of the limited exercise of the authority.

Now that large volume imports have become a distinct possibility, however, it has become imperative for the United States Government to establish some guideposts for the issuance of these permits. Since they are Presidential permits, presumably the standards could not be found in the Natural Gas Act. Accordingly, it is reasonable to expect that the Executive Branch of the Government will express some statement of policy in the foreseeable future with respect to the standards which can be expected to govern the issuance of these permits.

Presumably, again, these standards would require the cooperation of agencies other than the Federal Power Commission since so many interests are involved. In any event, I have complete confidence that neither the lack of such standards now, nor the form they will take ultimately will impede the cordial exchange of energy between the United States and Canada.

On the other hand, Canada too has its own statutory powers and responsibilities which it must observe. I am not familiar with them in detail and have no opinion whether they need further amplification or modification. This question properly may be reserved to the internal responsibility of that nation and I express no comment on it.

In Canada the only authority so far vested in a Governmental Dominion Ministry is found in the Pipelines Act. Construction of a section of an interprovincial or international gas or oil pipeline may not be commenced without leave of the Board of Transport Commissioners for Canada. Applications for leave to construct pipelines are usually set down for public hearing after notice to interested parties by mail and newspaper advertisement.

Leave has been granted to construct such major pipelines as the Trans-Canada natural gas line from Alberta to points in Ontario and Quebec; the Westcoast Transmission gas line from the Peace River areas to serve Vancouver and other points in British Columbia and markets in the United States. Major considerations in such applications are public interest, financial responsibility of the company and the economic feasibility of the project.

The Board may make regulations providing for the protection of property and the safety of the public and of the company's employees in the operation of pipelines.

It may make orders and regulations with respect to all matters relating to traffic, tolls and tariffs of oil pipelines, but it does not have similar powers over gas pipelines.

The experience of the Canadian Government in authorizing exports of gas does not lend itself to analysis to determine policy. Moreover, the pending study being made by the Borden Commission will develop this subject at some length.

Through sources such as newspapers and trade journals I am informed that briefs have been filed to the Borden Energy Commission by the several parties interested in the problem. Some of them apparently have called for a national policy in Canada that will assure development of the gas industry serving Canadian consumers while at the same time providing for the exportation of the surplus gas. The *New York Times* on February 13 reported that the Canadian Petroleum Association had taken a position that gas exports from Canada could go a long way in stimulating investment capital to developed the vast reserves in western Canada.

Since it is reliably reported in the press of as recently as February 22 that the Borden Commission will definitely make an interim report on the problem of natural gas exports as soon as possible, it is reasonable to expect that a statement of opinion on this important matter is not far away.

Finally, my optimism derives from my confidence that cordial and friendly relations between Canada and the United States will continue. I believe this is the strongest indication and soundest basis for judgment that the ultimate conclusions on the policy of construction of international pipelines will coincide with the best interests of both Canada and the United States.

I have no comment on pending applications for specific export authority into the United States. Naturally, these are in process of litigation before the Commission and on them as you will readily understand, my lips are sealed.

Neither do I comment on the possible outcome of any of the many issues which the Borden Commission necessarily must consider. Indeed, like the applications pending before the Conservation Boards of the several Provinces, I respect the National and Provincial integrity of these decisions.

These remarks are directed entirely toward the long-range prospect of satisfactory solution of the problem of distributing the energy resources found in the far Pacific Northwest. I close with this repeated hope and confidence that the solutions to these problems in the governmental and legal field will be as swift and sure and practical as the solutions in the engineering field which have been reached by men of your learned discipline. ★ ★ ★

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Canadian News Notes

Contract Let for Gas Line from Pembina Field

Mannix Co., Ltd., Pipeline Division, has been awarded a contract by Northwestern Utilities, Ltd., of Edmonton to lay its entire main line and gathering system for transmission of associated gas from the Pembina oil field to the Edmonton city distribution system. The job involves 45 miles of 16-in. main line construction and 49 miles of gathering lines in the field. The September scheduled completion date is designed to coordinate with completion of conservation facilities in the field. At present a large quantity of gas is being flared.

The contractor began clearing right-of-way on February 18 and plans to lay riprap over the frozen muskeg before the spring thaw so that the whole main line spread will be able to work from the riprap roadway through the muskeg region. One section of 26 miles, now in the ground, is being purchased intact from Pembina Pipe Line, Ltd., which laid it last year as a loop of its main oil pipeline and found it surplus due to the sharp decline in marketing of Alberta crude.

Pipe is being supplied by Page Hersey Tubes, Ltd., Welland, Ontario, in the 10-in. and 16-in. diameters, and by Alberta Phoenix Tube & Pipe, Ltd., in the small gathering system diameters. Coal tar enamel is to be non-plasticized 300-deg type supplied in equal quantities by Koppers Products, Ltd., and The Barrett Company, Ltd. Outer wrap will be glass or felt, with no inner wrap.

Sammy Steffen is spread superintendent, with headquarters in Drayton Valley.

Loop Contract Awarded By Interprovincial

Howard C. Bauer will head up the pipeline division of Piggott Construction, Ltd., Calgary, which has been awarded the contract by Interprovincial Pipe Line Company to lay 82 miles of 24-in. loop in Alberta and Saskatchewan. Bauer, who spent several construction seasons with Dutton-Williams Brothers, Ltd., recently joined Piggott as vice president.

The loop sections are 20 to 21 miles each, and are on the downstream sides of four pumping stations, at Edmonton and Hardisty in Alberta, and Kerrobert and Loreburn in Saskatchewan.

Piggott's first field warehouse probably will be set up at Elbow, Saskatchewan, and the spread will move from the east end of the job to the west end, terminating at Edmonton pumping station. Scheduled start date is before June 1, with completion guaranteed by September 1.

Pipe is being supplied from the Welland, Ontario, mill of Welland Tubes Limited. Engineers and speed increasers for the additional station units in the 1958 program are being bought from Dominion Engineering, Ltd., of Lachine, Quebec. Pumps are being supplied by Bingham Pump Company. The contracts have not yet been awarded for the station work.

Westspur Throughput Continues to Increase

Westspur Pipe Line Company set a new record for daily average throughput in January, and the February figures not compiled with this was written were expected to go still higher. January traffic was 80,890 bbl per day average, where February throughput was estimated at 81,800 bbl per day. A year previously the line was carrying only half this volume.

Although domestic deliveries to Ontario refineries were to be reduced slightly in February, the export market continued strong, with substantial increases in average daily throughput to the Lake Superior refinery at Superior, Wisconsin, and slight increases to the International refinery at Wrenshall, Minnesota, and the Great Northern refinery in St. Paul Park, Minnesota.

Trans Mountain Profits Showed Increase in 1957

D. M. Morrison, president of Trans Mountain Oil Pipe Line Company, has announced that the company and its subsidiaries had a net profit in 1957 of $8,306,000, or $5.52 per share.

Net profit in 1956 was $6,991,000 or $4.65 per share.

Pincher Creek Line Work To Begin Immediately

Contract for the 145 miles of 24-in. gas pipeline from the Pincher Creek field to Princess Junction, in southern Alberta, has been awarded by The Alberta Gas Trunk Line Company, Ltd., to Piggot Construction, Ltd., Pipe Line Division, Calgary. The value of the contract is $1,800,000. J. C. Mahaffy, general manager of Trunk Line, said the job was scheduled to begin immediately with completion by September 1.

H. C. Bauer, vice president of Piggott, will be in charge of construction, with Carl Bills as spread superintendent. The entire job will be done with one spread.

Total cost is estimated at $11,000,000. Pipe is being supplied by Welland Tubes, Ltd., Welland, Ontario, and at mid-March more than 100 miles had been delivered and stringing was under way. Stringing was subbed to Hutchison Construction, Ltd., of Leduc, with assistance from Campbell, McLeod & Campbell, Ltd., Edmonton.

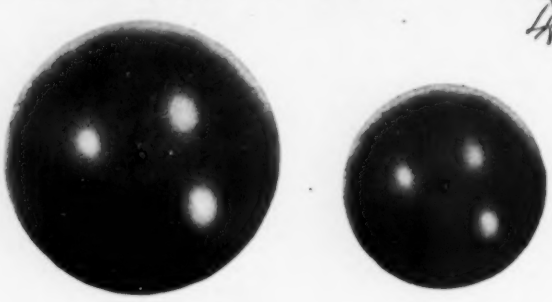
One of the unusual features of the job is the crossing of 12 major irrigation ditches on the southern end of the line, near Lethbridge. These crossings have to be completed by May 1 to avoid interference with normal farm irrigation in the summer. Another 100 crossings of smaller ditches, approximately, occur in a 45-mile area and will require going under with the pipe, probably by boring.

Three major river crossings are involved in the Trunk Line job, and these have been let separately to Fulton Banister, Ltd., with work now in progress. They are the Oldman and Bow Rivers, with 24-in. pipe, on the 145-mile section, and the Red Deer, with 26-in. pipe, on the northern extension to Princess, for which the contract was to be awarded later in March. This job involves 25 miles of 26-in. line. The river crossings are all scheduled for completion before the spring break-up.

"Are you sure the specs called for six-inch pipe?"

New

"Something From The Irishman"



PIPELINE SPHERES . . .

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Over four years of intensive research involving the testing of literally hundreds of rubber compounds in the laboratory, and thousands of miles of field tests in Products Lines have established the superiority of the **Maloney Pipe Line Sphere** over existing methods of product separation and meter calibration. This superiority is demonstrated in **ease of handling** — saving costly man-hours of labor; **long life** — reducing expensive replacement time and labor; and **flexibility** — complete adaptability to automated systems and ability to follow flow through short radius bends, tees, etc. All of these advantages are obtained with a marked reduction in interface contamination and no loss in accuracy.

The **liquid-center rubber Sphere,** with its obvious handling advantages, has an even greater advantage in wear characteristics, with an infinite number of wearing surfaces in comparison to the conventional dumbbell pig. This advantage is apparent in test results of over 500 miles without excessive wear, indicating that in normal use **runs of over 1,000 miles can be expected.**

Research on the **Maloney Pipe Line Sphere** is continuing in an effort to determine the final extent of its overwhelming superiority when compared with other methods of calibration and separation. Other uses for the **Pipe Line Sphere,** such as water or product removal, etc., are also being investigated.

Maloney Pipe Line Spheres are presently available in the following sizes: 4, 6, 8, 10, 12, 14, 16, and 20 inches. Our Engineering and Research departments are prepared to make specific recommendations for your particular applications. Additional information is contained in bulletin PS. Your inquiries are invited.

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News

Pipeline Volume Increased, Revenue Decreased in 1957

More crude oil and refined products were transported in 1957 than during the previous year, but revenues decreased 1.3 percent, the Interstate Commerce Commission reports. Sixty-nine major companies moved 4,447,835,697 bbl in 1957 and 4,388,066,148 bbl the previous year. Revenues for 1957 were $670,690,411 in 1957 compared with $679,806,718 in 1956.

Twenty pipeline companies had revenues totaling in excess of $10,000,000.

Atlantic Pipe Line Company, $15,248,971, down 5.4 percent; Buckeye Pipe Line Company, $18,703,398, down 1.6 percent; Great Lakes Pipe Line Company, $38,792,549, up 2.2 percent; Gulf Refining Company, $36,121,724, down 9.2 percent; Humble Pipe Line Company, 37,489,562, down 3.3 percent.

Interstate Oil Pipe Line Company, $20,213,106, down 3.3 percent; Lakehead Pipe Line Company, $17,086,399, up 2.7 percent; Magnolia Pipe Line Company, $36,410,675, down 6.5 percent; Mid-Valley Pipeline Company, $12,065,356, down 17.5 percent; Ohio Oil Company, Pipe Line Department, $15,255,216, down 2.7 percent; Phillips Pipe Line Company, $32,123,824, up 3.7 percent.

Plantation Pipe Line Company, $29,641,451, up 11.7 percent; Platte Pipe Line Company, $12,667,241, up 0.8 percent; Salt Lake Pipe Line Company, $10,460,705, down 7.3 percent; Service Pipe Line Company, $66,482,485, down 5.3 percent; Shell Pipe Line Corporation, $30,891,177, down 6.4 percent; Sinclair Pipe Line Company, $44,579,926, fractionally higher; Sun Pipe Line Company, $13,558,990, down 9 percent; Texas-New Mexico Pipe Line Company, $11,534,794, up 1.4 percent; Texas Pipe Line Company, $37,190,177, down 2.7 percent.

Big Names Will Instruct at Corrosion Short Course

Internationally recognized men will serve as instructors for the third annual Appalachian Underground Corrosion Short Course at the University of West Virginia, June 10-12. They include W. H. Stewart, president of the National Association of Corrosion Engineers, who will be the keynote speaker; Dr. Karl G. Deuber, M. C. Miller, William J. Kretschmer, C. C. Cox, Lewis H. West, Charles C. Stoneking, Joseph Schauers, and H. W. Hosford.

This year's course will include especially timed subjects such as progress in the use of epoxy coatings and discussions on microbiotic deterioration of engineering materials. To date, 35 firms have planned to exhibit their products.

PIPELINE PERSONALS

Henry E. Littlehales has been named assistant director of public information for the American Gas Association. **Lorne S. Waddell,** last with the Tom Compere & Associates public relations firm in New York, succeeds him as manager of press relations.

Before joining AGA in 1956, Littlehales was in public relations with Rowe-Doherty Associates in New York, worked for the Philadelphia Inquirer and other newspapers in Pennsylvania and West Virginia, and taught journalism at Temple University.

Harry H. Siert, treasurer, has been promoted to vice president and treasurer of Northern Natural Gas Company. Other promotions announced include: **Frank H. Roberts** to chief accounting officer and

H. H. Siert

F. H. Roberts

Ernest M. Petersen to assistant to the president and assistant secretary. Roberts was assistant controller, and Petersen was administrative assistant to the president before their promotion.

E. M. Petersen

J. R. Ashley

J. R. Ashley has been promoted to general superintendent of the communications and electrical department of Magnolia Pipe Line Company with headquarters in Dallas. Ashley replaces **D. H. Levy** who is retiring. He formerly was assistant superintendent of that department.

William B. Padon of Tulsa, Oklahoma, has been elected a vice president and a director of Transwestern Pipeline Company. Padon also is vice president in charge of projects and planning of Warren Petroleum Corporation, a position to which he was named early in 1956, after serving for some time as manager of that corporation's special products sales department.

Donald L. Barger has been appointed superintendent operations of New York State Natural Gas Corporation. He had been superintendent production and transmission for the Pittsburgh-based wholesale firm since 1955.

William D. Buchanan is named to head a newly formed eastern division of New York State Natural Gas with headquarters at Utica, New York. He was formerly eastern district superintendent since 1953.

Roy A. Doman was named manager engineering. Doman had been chief engineer since 1956, joining New York Natural in 1951 as chief civil engineer.

John E. Stuchell was named assistant to superintendent operations of New York State Natural Gas. A resident of Westfield, Pennsylvania, he will move to Pittsburgh where the company has its headquarters. He has served as chief district engineer of Sabinsville district and district superintendent of Harrison district since 1955.

J. D. Roberts, director and vice president in charge of distribution for Mountain Fuel Supply Company, has retired. He will remain as director.

H. Barksdale Brown, marine coordinator for the transportation department of the Gulf Oil Corporation, has been appointed general coordinator of that department and will be responsible for the coordination of all forms of transportation for the company and its subsidiaries. **Wessel C. Brodhead,** formerly manager of costs and economic performance of Gulf's New York marine department, has been transferred to Pittsburgh and appointed marine coordinator, succeeding Brown. Brodhead will be responsible for the coordination of all marine transportation including planning, economics, cost control, scheduling, etc., reporting to Brown.

Dennis L. Newberry has been appointed manager of gas sales, and **Glover H. Cary Jr.** has been appointed industrial representative, Texas Gas Transmission Corporation. Newberry will be responsible for obtaining market data from the company's customers and for coordinating gas sales development by present and potential customers, including both industrial customers and operators of natural gas distribution systems. Cary's work will be in connection with Texas Gas efforts to further industrialize those area of the eight states to which it delivers natural gas. These states are Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, Illinois, Indiana and Ohio.

T. K. Davis, J. L. Parrish and **B. J. Whitley** have been designated general superintendents, reporting to **E. S. Murray,** vice president of operations, Tennessee Gas Transmision Company. Davis will be in charge of the compressor, measurement and gas control sections. Parrish will be responsible for pipeline construction, research, corrosion control and radio operations. Whitley will be in charge of the operation and maintenance of pipeline facilities, in addition to his present assignment as manager of the transmission rights-of-way section. **Ross O. Parker Jr.,** and **George W. White** have been named assistant chief engineers.

Henry E. Hockeimer has been promoted to manager of the field engineering department of Philco Corporation's government and industrial division. He has been assistant manager of field engineering since 1955.

Richard R. Wilber, assistant supervisor in the Standard Oil Company (Indiana) crude oil coordination department at Chicago, has been appointed assistant manager of crude oil supply with American Oil Company, a Standard Oil affiliate.

The Pipe Liners Club of Tulsa, Tulsa, Oklahoma, has elected new members: **T. R. Bradley,** Warner Lewis Company; **S. J. Brady,** Phillips Petroleum Company; **Emmerson H. Clark,** Engineering Construction Company; **Donald E. Driscoll,** Paul King Company; **Charles Fitzgerald,** honorary; **Fred W. Hoover,** Crane Packing Company; **T. J. Ingram,** Gulf Refining Company; **V. M. Long,** Service Pipe Line Company; and **Oscar Wolf,** honorary.

James G. Elliott has been promoted to superintendent of right of way for the nine-state area in which Texas Gas Transmission Corporation pipelines are located. **M. E. Bless,** now of Memphis, Tennessee,

J. G. Elliott

M. E. Bless

and of **W. T. Turner Sr.,** Monroe, Louisiana, were named division superintendents of land and lease. Bless will be located at Owensboro where he will supervise Texas Gas pipeline right of way activities in Kentucky, Illinois, Indiana and Ohio. Turner will continue to be located at the company's Monroe offices where he will be responsible for pipeline right of way in Tennessee, Mississippi, Arkansas, Louisiana and Texas. Elliott was division superintendent of land and lease prior to the promotion in which he has given responsibility for system-wide right of way functions.

W. T. Turner Sr.

O. W. Wade

A firm specializing in engineering services related to corrosion control in the petroleum and pipeline industries has been formed by **O. W. Wade** of Houston, Texas. Wade, president of the new firm, known as World Supply Company, with offices at 3400 Montrose Boulevard, Houston, has been chairman of the American Gas Association's corrosion committee, has headed that group's instrumentation committee, and has served on their committee for development and screening of internal pipe coatings. Formerly chief corrosion engineer for Transcontinental Gas Pipe Line Corporation, he directed the firm's extensive program of pioneering research and development in the fields of external and internal pipe coating.

Personals

Leslie H. True has been elected to the board of directors of the Mercantile National Bank, Dallas, it was announced by Milton Brown, president. True is president of Magnolia Pipe Line Company and a director of Magnolia Petroleum Company. In addition to the executive offices he holds with the Magnolia companies, he is a director of the South Saskatchewan Pipe Line Company of Canada with general offices at Regina, Saskatchewan; a director of Project Five Pipe Line Corporation, and also a director of the Southland Life Insurance Company of Dallas.

L. H. True

Clare G. Miller has been appointed president and **T. J. (John) Behrenfeld** vice president of M. J. Crose Manufacturing Company, Inc., pipeline construction equipment firm with headquarters in Tulsa, Oklahoma. The appointments were occasioned by the resignation of president **D. Michael Curran,** who will remain active with the company as consultant. Miller has been vice president of Crose the last three years. Behrenfeld joined Crose nine years ago and has been sales manager for the last two years.

C. G. Miller

John Behrenfeld

Lawrence H. Riddile has been named superintendent field Oakland district and **W. Park Steele** as superintendent stations Oakford district of New York State Natural Gas Corporation. Riddile was assistant Oakford district superintendent. Steele was formerly chief compressor station engineer.

Nelson A. Ingersoll has been appointed superintendent of the Harrison district of New York State Natural. He succeeds **John E. Stuchell** who moves to another assignment in Pittsburgh, Pennsylvania. Ingersoll was previously a foreman.

David H. Levy, of Dallas, a director of Magnolia Pipe Line Company, has retired. He joined the company as an electrical engineer in 1927, and was elected to its board in 1957. Since 1943 he has been general superintendent of the company's communications and electrical department.

D. H. Levy

Levy was born in 1893 in Waco, Texas. He was graduated from Texas A&M College with a degree in electrical engineering in 1914. During World War I he served as a captain in the U.S. Corps of Engineers in France and Germany. His entire employment by Magnolia Pipe Line Company has been in the company's communications and electrical operations.

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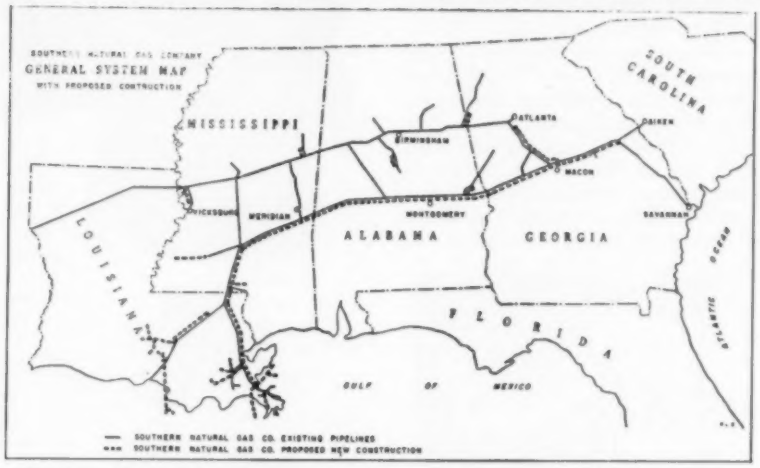
"LET'S SEE NOW—WHAT WAS I GOING TO DO TONIGHT?"

Pipeline Projects

Southern Natural to Spend $110,000,000 on Construction



Southern Natural Gas Company has filed an application with the Federal Power Commission requesting authority to expand its natural gas pipeline transmission facilities, C. T. Chenery, board chairman, announces. He said that the proposed expansion would increase present delivery capacity of approximately 1 billion cu ft per day by more than 300,000,000 cu ft. The application contemplates the expenditure of approximately $64,500,000 and this, together with expenditures under other applications currently pending, would involve a total of approximately $110,000,000.

Chenery stated that the proposed program involves the largest single expansion in the history of the company, but that the consummation of the program will be complicated by the "Memphis decision." He said that the company would find it difficult, if not impossible, to raise the money required for the construction program unless the decision was reversed by the Supreme Court, or unless the company is able to work out a satisfactory settlement with its customers of presently pending rate proceedings and make arrangements that would permit it to apply, as it had been able to do prior to the Memphis decision, for such additional rate increases as might be needed to cover higher gas and other costs resulting from the proposed expansion program.

The program contemplates the installation of about 1,200 miles of pipe to gather gas from about 35 new fields in south Louisiana and in the Gulf of Mexico and to transport it to customers in Mississippi, Alabama, Georgia, and South Carolina. In addition to connecting new gas fields, the new pipelines would parallel existing lines along the Louisiana supply system and from Gwinville, Mississippi, to Wrens, Georgia. The program also provides for the addition of nearly 16,000 hp to existing compressor stations and for a parallel line between Macon and Atlanta, Georgia.

"Work on the new lines would start as soon as financial arrangements are made and approval is granted by the Federal Power Commission. It should be possible to make substantial progress with the construction during 1958 and complete it during the summer of 1959," C. P. Rather, president, said.

Final Approval Given for El Paso Natural Work

El Paso Natural Gas Company has been authorized to construct and operate natural gas facilities, estimated to cost approximately $2,427,000, in Crane County, Texas, and Lea County, New Mexico. FPC also authorized Phillips Petroleum Company and Cabot Carbon Company to sell natural gas to El Paso.

El Paso will construct additional purification and dehydration facilities and install an additional 4050 hp at its existing McElroy-Crane plant in Crane County, at a cost of about $2,414,000, and will construct about 4350 ft of 4½-in. pipeline from Cabot Carbon's King plant in Lea County, to its Permian-San Juan main line, with appurtenant facilities, at a cost of approximately $13,000. The FPC, on November 29, 1957, granted El Paso temporary authorization for the construction and operation of these facilities.

An Ohio Project for Manufacturers Light

The Manufacturers Light and Heat Company has asked FPC for authority to construct and operate natural gas facilities, at an estimated cost of about $1,160,300, and to abandon certain other facilities in Ohio and West Virginia. Manufacturers proposes to construct about 21.24 miles of various diameter transmission pipeline, 0.23 miles of 16-in. river crossing, and a metering and regulating station to serve Olin Mathieson Chemical Corporation's aluminum plant near Buck Hill Bottom, Monroe County, Ohio.

The company proposes to abandon approximately 9.81 miles of small diameter transmission line.

Intermediate Station for Increased Flexibility

The Federal Power Commission has granted Texas Eastern Transmission Corporation temporary authorization for the construction and operation of a 6600-hp compressor station near Blessing, Matagorda County, Texas.

Texas Eastern proposes to install six 1100-hp units in the new station at an estimated cost of approximately $2,388,400. The new station will be located at the junction of Texas Eastern's existing 30-in. Vidor-McAllen and 24-in. Provident City-Blessing lines. The company's application said the 30-in. line originating at McAllen, Texas, extends about 357 miles to the Mont Belvue, Texas, compressor station without any intermediate compression. Construction of the proposed station, approximately 240 miles from McAllen, would permit increased operating flexibility and positive control over line pack.

Transwestern Contracts Gas to Pacific Gas Supply

Pacific Gas Supply Company has contracted for 350,000,000 cu ft of gas per day from Transwestern Pipeline Company. First deliveries under a 20-year agreement are scheduled to begin November 1, 1959.

Transwestern, with headquarters in Houston, Texas, plans to begin construction of a 30-in. pipeline from West Texas, New Mexico, and the Four Corners area to the California border this fall.

Approval for the system is now pending before the Federal Power Commission and the California Public Utilities Commission.

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Projects

Continental Expanding in Rocky Mountain Area

A $430,000 Rocky Mountain area expansion project by Continental Pipe Line Company, including new delivery facilities at Cheyenne, Wyoming, and three new pump stations in Wyoming has been announced.

Contract for the project has been awarded to Oil Capital Construction and completion is expected by June 15.

At Cheyenne, Continental Pipe Line will build both delivery facilities and a pump station. The terminal will have three storage tanks for crude oil, with a total capacity of 100,000 bbl. Of the two additional pump stations one will be constructed near Little Bear, Wyoming, some 33 miles north of Cheyenne, and the other at a point 56 miles north of Cheyenne, midway between Little Bear and Guernsey, Wyoming.

Upon completion of the expansion project, the Guernsey-to-Cheyenne portion of the crude line will have an initial capacity of 46,000 bbl daily and the Cheyenne-to-Denver part of the line will have an initial capacity of 34,000 bbl daily.

The line connects with the Platte, Butte, and Service pipelines at Guernsey and serves seven fields in Wyoming and three in Colorado.

Facilities to Serve Storage Field Approved

The Federal Power Commission has authorized Cities Service Gas Company to construct and operate natural gas facilities in Kansas, and to abandon other facilities in Texas, Oklahoma, and Kansas. Estimated cost is approximately $3,641,000, including $280,000 reclamation costs.

Cities Service will construct a 7000-hp compressor station and 6.37 miles of 30-in. line in Montgomery County, Kansas, and 18.0 miles of 26-in. line in Anderson and Franklin counties, Kansas.

FPC also authorized the abandonment of two 1000-hp compressor engine units in Hemphill County, Texas; two 1000-hp compressor engine units in Woodward County, Oklahoma; the 6300-hp Petrolia station in Allen County, Kansas; the 8450-hp Grabham station, and 6.37 miles of dual 16-in. line in Montgomery County.

Purpose of the proposed facilities is to make gas from Elk City Storage field available to markets on peak days. Deliveries from storage fields on peak days will increase from 421,698,000 cu ft in 1957-58 to 521,155,000 cu ft in 1959-60, the applicant said.

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Saskatchewan Power Has Scheduled Huge Program

The largest single program of main line construction in its history is scheduled for 1958 by Saskatchewan Power Corporation. Hon. Russell Brown, government minister in charge of the corporation, has announced three major items involving 255 miles of main transmission line and a gathering system requiring 75 miles of lines.

The biggest individual job is the main line extension and gathering system for the Hatton gas field on the western edge of the province. This will take 90 miles of 16-in. pipe for the line from the field to Success, where it will link up with the existing main line to Moose Jaw. The 75-mile gathering system will be laid in the Hatton field, which has some 12 scattered wells.

Another 40-mile 12-in. line will extend the main line from Moose Jaw to Regina, and 125 miles of 10-in. line will be laid to extend service to Weyburn and Estevan, the principal cities in the southeastern sector. Several laterals and local distribution systems will be announced in detail as soon as the towns to be served have been selected. Total mileage, exclusive of distribution services, will come to well over 350 miles. At the end of 1957 the system consisted of 574 miles of main transmission lines and 100 miles of gathering systems.

Southern Natural Proposes South Louisiana Additions

Southern Natural Gas Company, to connect additional gas reserves to its southern Louisiana system, has asked authorization to construct gathering facilities that will cost an estimated $4,133,700. The project will include 45.3 miles of various diameter supply lines, 2000 additional horsepower at its Toca compressor station, 660 additional horsepower at its Franklinton station, and certain measuring facilities.

Southern Natural also has asked to construct 12.5 miles 10-in. line and a measuring station to take gas from the Tantine field in Plaquemines Parish, Louisiana. The line would connect with the company's system on the west bank of the Mississippi River.

Kentucky Gas Plans to Parallel Part of System

Application has been filed by Kentucky Gas Transmission Corporation for authority to construct and operate 20.5 miles of 26-in. natural gas transmission pipeline in Kentucky.

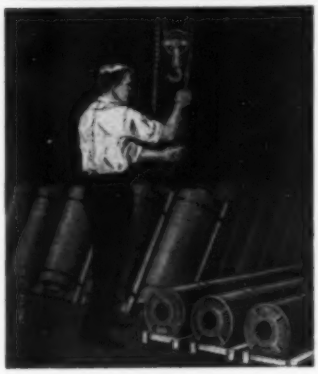
Kentucky Gas proposes to construct the line parallel to its existing 20 and 24-in. lines extending from its Foster regulating station in Bracken County northwesterly to its Cold Springs measuring station in Campbell, Kentucky.

United's $33,000,000 Project Is Approved

The Federal Power Commission has authorized United Gas Pipe Line Company to construct and operate approximately 203 miles of 30-in. natural gas pipeline paralleling an existing line between New Orleans, Louisiana, and Mobile, Alabama, at an estimated cost of about $33,770,618.

United will construct the facilities in two phases, the first including about 78.7 miles of line from a point near New Orleans to a point in Hancock County, Mississippi, and 38 miles from a point in Harrison County, Mississippi, to a point in Jackson County, Mississippi. The second phase will include a total of about 86 miles of pipeline segments paralleling sections of the company's southeast Louisiana-Mobile line.

The additional facilities, United said in its application, will enable it to continue to supply the increasing gas requirements of its present customers in the Mobile-Pensacola, Florida, area and along the route of the New Orleans-Mobile line. The gas will be drawn in large measure from its south Louisiana sources of supply, which will, in part, replace other declining sources of supply serving that area.



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Pipe Line Welding School Graduates Its First Class

The Pipe Line Welding School at Kilgore, Texas, sponsored by the Pipe Line Contractors, has graduated its first 48 men. No formal graduation ceremonies were held, but each of the students was presented with a certificate evidencing the fact that he had satisfactorily completed the pipeline welding course and had passed qualification tests in accordance with API Standard 1104, under the observation of representatives of the API-AGA Joint Welding Committee.

The Pipe Line Contractors Association is providing the funds required to operate the school except for several donations by operating companies. The Pipe Fitters Union, with which the Pipe Line Contractors Association has negotiated a National Pipe Line Agreement, is cooperating in the training program, and the school itself is administered by the Petroleum Extension Service of the University of Texas.

Students for the school are first recommended either by members of the Pipe Line Contractors Association or by the Pipe Fitters Union. Thereafter, applications are filled out by those whose names have been submitted and a screening committee selects those to attend the classes.

In the first class of 48 students, all 48 completed the training course in six weeks and passed their qualification tests under the watchful eyes of two company inspectors, who have stated that in their opinion the course of training and the degree of instruction given at the school is of the best.

The second class of 48 students is now in session at Kilgore and will be followed by a third class, which will begin approximately April 7.

Caplan Named Manager RCA Communications Products

Appointment of Norman Caplan as manager, Communications Products Department, Telecommunications Division, Radio Corporation of America, is announced by T. H. Mitchell, general manager of the division.

Formerly manager, Mobile Products Department, of Bendix Aviation Corporation, Caplan, in his new position, will be responsible for RCA's engineering, manufacturing, and marketing activities in the fields of mobile, microwave, and marine communications. He succeeds C. M. Lewis, who was recently named manager, Marketing Plans, RCA Telecommunications Division.

A graduate of Rensselaer Polytechnic Institute in 1940, with a BS degree in electrical engineering, Caplan has been responsible for basic contributions to the development of airborne radar and navigation equipment. He is chairman of the policy committee, Mobile Communications Section, of the Electronics Industry Association, and a senior member of the Institute of Radio Engineers.

Sixth Welding Show Promises to be Largest

The sixth annual welding show is expected to outstrip all of its predecessors in terms of attendance, number of products shown, companies participating, and size of the exhibit floor, according to those in charge of its staging.

It is scheduled for the Kiel Auditorium, St. Louis, Missouri, April 15-17.

The American Welding Society, which sponsors the exposition, will, at the same time, conduct its annual national spring meeting at the Hotel Statler, for the five days from April 14 to 18. This meeting will have papers presented by 95 authors on the very latest in research in the science and art of welding. The metals engineering division of the American Society of Mechanical Engineers will co-sponsor a number of the sessions.

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P. O. Box 1589 • Dallas

CHANGE MY ADDRESS, beginning with the_____ issue

FROM:_____

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WITH THE PIPELINE CONTRACTORS

● **Mannix Company, Ltd., 737 Eighth Avenue West, Calgary, Alberta.** Has 93 miles of 30-in. for *Northern Ontario Pipe Line Crown Corporation* from a point 30 miles west of Hearst running to Kapuskassing, Ontario. Right of way clearing is being completed and pipe laying is to begin between May 15 and June 1. Has 50 miles additional work for *Pembina Pipeline Company*. This is a continuing contract with Pembina, of which 500 miles have now been completed since 1954. Has 45 miles of 16-in. gas transmission line from Pembina field to Calmar, Alberta, and 47 miles of 4 to 16-in. gas gathering lines in Pembina field for *Northwestern Utilities, Ltd.*; one 16-in. river crossing of the North Saskatchewan River is included in this project.

● **Hunsaker Trucking Contractor, Inc., P. O. Box 97, Carrollton, Texas.** Has stringing contract for 90 miles of 16-in. line between DeLeon and Hawley, Texas, for *Humble Pipe Line Company*.

● **Houston Contracting Company, 2807 Buffalo Speedway, Houston 6, Texas.** Has approximately 20 miles of 12-in. natural gas line for *United Gas Pipe Line Company* near Moss Point, Louisiana. Has approximately 43 miles of 12-in. and smaller natural gas line for *Southern Natural Gas Company* southeast of New Orleans, Louisiana; this is a lay barge and quarter boat operation.

● **O. R. Burden Construction Corporation, Box 5216, Tulsa, Oklahoma.** Has 90 miles of 16-in. for *Humble Pipe Line Company* from Humble's Comyn station in Comanche County to its Hawley station in Jones County, Texas.

● **E. K. Aldridge & Sons, Inc., Box 1324, Athens, Georgia.** Has 60 miles of ¾ to 4-in. line from Reform to Vernon, Alabama, for *Lamar County Natural Gas Authority*.

● **Clear Span Engineering Company, 4118 Fannin, Houston, Texas.** Has 540 ft 18-in. pipeline crossing using suspension bridge for *Houston Pipe Line Company;* crossing is on the Trinity River 10 miles north of Liberty, Texas.

● **Collins Construction Company, P. O. Box 86, Port Lavaca, Texas.** Has 26 miles offshore trenching for the *CATC Group* from Grand Isle, Louisiana, to a point 26 miles out into the Gulf of Mexico. Marine Gathering Corporation is the prime contractor, and Collins is burying the line being laid by Marine Gathering's pipeline barge. Has trenching contract for 57 miles of 12 to 26-in. lines running from shore to offshore facilities at Cameron, Louisiana, for *Tennessee Gas Transmission*. Has contract with *Accra-Mobil Overseas Oil Company* for 11,500 ft of 12-in. sea-loading line from shore at Accra, Ghana (Africa) to a depth of 50 ft. Also has 32,000 ft of 24 and 12-in. sea-loading line for *American Independent Oil Company* at Kuwait into the Persian Gulf. Has trenching contract with *Commonwealth Oil Company* for 10.6 miles of 12-in. offshore line in West Delta block in Gulf of Mexico.

● **Western Pipe Line, Inc., 1011 San Jacinto, Austin 66, Texas.** Has 94 miles of 30-in. for *Northern Ontario Pipe Line Crown Corporation* between Hawk Lake and Hyndeman, Ontario.

● **Majestic Contractors Limited, 408 Royal Trust Building, Edmonton, Alberta.** Has contract for the 70.9 miles, 30-in. Spread X of *Northern Ontario Pipeline* between Beardmore to Longlac, Ontario. Has undetermined amount of gathering system for *Producers Pipeline Ltd.* in the Estavan, Saskatchewan, area. Has contract to lay city distribution system in Cooksville, Ontario, for *Consumer Gas Company*. Has city distribution system in Guelph, Ontario, for *Union Gas of Canada*. Has contract for testing *Trans-Canada Pipeline's* line from Alberta to Winnipeg, Manitoba.

● **Hallmac Construction Company, 3701 Buffalo Drive, Houston, Texas.** Has undetermined amount of various size pipe to lay for *Pacific Northwest Pipeline Company* for gathering system in Four Corners area. Also has undetermined amount of gathering system line for *El Paso Natural Gas Company* in the Four Corners area.

● **Vaughn and Taylor Construction Company, Inc., P. O. Box 3266, Odessa, Texas.** Has contract for 48 miles of 8, 6, and 4-in. line between Kermit and Goldsmith, Texas, for *El Paso Natural Gas Company*.

● **Missouri Valley Dredging Company,** 1331 South 20th Street, Omaha, Nebraska. Has 5.6 miles of 24-in. for *Laurel Pipe Line Company* from Eagle Point, New York, to west bank of Delaware River including the river crossing. Also 20 miles of 24-in. from that point to Booth station site in Delaware County, Pennsylvania.

● **Engineers Limited Pipeline Company,** 225 Bush Street, San Francisco. Has 106 miles of 24-in. for *Laurel Pipe Line Company* from Booth station, Delaware County, Pennsylvania, to Mechanicsburg.

● **Fulton Banister, Ltd., 625 Northern Hardware Building, Edmonton, Alberta.** Has 100 miles of 18-in. for *Alberta Gas Trunk Line Company, Ltd.*, from Burstall at the Alberta border to Provost, Alberta. Also has 22 miles of gas gathering line in the Provost field for *Provo Gas Producers, Ltd.*, consisting of constructing gathering system and wellhead tie-ins—3 to 12-in. pipe; this gas to be fed to Alberta Gas Trunk Lines.

● **Banister Construction, Ltd., 625 Northern Hardware Bldg., Edmonton, Alberta.** Has undetermined amount of 2 to 6-in. extensions to existing systems in cities and towns in Saskatchewan, plus approximately 5000 consumer service connections, for *Saskatchewan Power Corporation*. Has contract for construction of transmission and distribution system in the town of Wilkie, Saskatchewan, for the *Saskatchewan Power Corporation*.

● **Panama Inc., 1418 Melrose Blvd., Houston, Texas.** Has contract for 362 miles of 16-in. for the *Texas-New Mexico Pipeline Company* from Jal, New Mexico, northwestward. Has 193 miles of 4 to 24-in. line in Mocane and Laverne, Oklahoma, fields for *Colorado Interstate Gas Company*. For *Laurel Pipe Line Company*, 78 miles of 20-in. from Mechanicsburg, Pennsylvania, to Duncansville, 118 miles of 18-in. from the latter point to Aliquippa station, Pennsylvania.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

● **Williams Brothers Company, National Bank of Tulsa Bldg., Tulsa, Oklahoma.** Has 212.5 miles 20-in. crude line for *Socony Mobil Oil Company de Venezuela*. Line will extend from San Silvestre field to Puerto Cabello on the Caribbean Coast. For *Laurel Pipe Line Company*, 106 miles of 14-in. from Aliquippa station, Pennsylvania, to Cleveland, Ohio.

● **Troth Construction Company, Box 592, Britton, Oklahoma.** Has contract for 160 miles of 2 and 8-in. lines for gas distribution to communities in the Aberdeen, South Dakota, area, for *Northern Natural Gas Company*.

● **Canadian River Construction, 580 Hornby Street, Vancouver, British Columbia.** Has contract on Spread Y, containing 91.3 miles of 30-in. gas line from Longlac to MP 584.8 at the east bank of the Shekak River for *Northern Ontario Pipe Line Crown Corporation*.

● **Piggott Construction, Ltd, Calgary, Canada.** For *Interprovincial Pipe Line Company*, 82 miles of 24-in. loops in Alberta and Saskatchewan. For *Alberta Gas Trunk Line Company*, 145 miles of 24-in. from Pincher Creek field to Princess Junction, Alberta.

● **Dutton-Williams Brothers, Ltd., North Canadian Oil Building, Calgary, Alberta.** Has 57 miles of 30-in. line for *Trans-Canada Pipe Line*. Has contract for 80 miles of gathering lines for *Westcoast Transmission Company's* natural gas grid system in the Peace River region; plans call for laying some 20-in. as an extension to the main line and also smaller diameter lines down to 6-in. for the Blueberry field.

● **Fish Service Corporation, M & M Building, Houston, Texas.** Has 67 miles of line for *Florida Pipeline and Storage Company* from Port Everglades to Homestead Air Force Base, Florida.

● **C. P. Bartley & Son Pipe Line Construction, P. O. Box 616, Tioga, North Dakota.** Has 121 miles of 2 through 12-in. gas gathering extensions for *Signal Oil & Gas Company* in the Newton, North Dakota, area.

● **Engineering-Construction Company, First National Bank Building, Tulsa, Oklahoma.** Has contract with *City of Macon, Missouri*, to lay 25 miles of 4 and 6-in. between Moberly and Macon, Missouri, and 12 miles of various size distribution lines in Macon.

● **G.E.T. Construction, Inc., 435 S. 116th St., Milwaukee, Wisconsin.** Has 46 miles of 24-in. loops in Wisconsin and Illinois for *Michigan Wisconsin Pipe Line Company*.

● **Four Way Company, Farmington Hwy., Aztec, New Mexico.** Has contract to lay 16-in. line for *Texas-New Mexico Pipeline Company*, for a distance of 150 miles southeast from the Aneth field in Southeast Utah.

● **Brown & Root, Inc., 4100 Clinton Drive, Houston, Texas.** Has contract with *Texas Eastern Transmission Corporation* to furnish field supervision for construction of 626 miles of 30-in. loops along the company's line between Beaumont, Texas, and Uniontown, Pennsylvania.

● **Holder Construction Company, Box 1438, Snyder, Texas.** Has contract on 134 miles of 6-in. products line for *Trust Pipe Line Company* between Hawley and Wichita Falls, Texas.

● **Mid-States Construction Company, P. O. Box 417, Mt. Vernon, Illinois.** Has contract for 50 miles of ¾ to 2-in. and 4 to 6-in. distribution and service lines in Desota, Missouri (Project 5), for *Missouri Natural Gas Company*.

● **F. E. Shaw, Ltd., 530 S. Vidal Street, Sarnia, Ontario.** Has 40 miles of 6 to 10-in. line for *Dominion Natural Gas Company, Ltd.*, in the Brantford, St. Catharines, and St. Thomas districts. Has 67 miles of 6 to 20-in. transmission lines for *Union Gas Company*, Chatam, Ontario, to Dawn, London, St. Marys, Stratford, Kitchener and Guelph.

● **Lone Star Pipe Line Constructors, Inc., 10301 Shady Trail, Dallas, Texas.** Has 143 miles of 20-in. crude line between Teague and Houston, Texas, for *Sinclair Pipe Line Company*.

● **Golightly Construction Corporation, Box 15243, 6450 Liberty Road, Houston 20, Texas.** Has 6 miles of 20-in. line on the Houston end of *Sinclair Pipe Line Company's* North Texas to Houston crude line.

● **Oklahoma Pipe Line Constructors, P. O. Box 13227, Dallas 20, Texas.** Has 100 miles of 30-in. for *Creole Petroleum Corporation* between Temblador and Caripito, Venezuela; this is the company's first Venezuelan venture since 1944. Has 50 miles of 22-in. loops for *Portland Pipe Line Corporation* and *Montreal Pipe Line Company;* 39 miles in U. S. and 11 miles in Canada. Has 90 miles of 30-in. (known as Spread 14) for *Trans-Canada Pipe Lines, Ltd.*, from Toronto, Ontario, northward.

● **Williams-Austin Construction Corporation, 3322 Grant Building, Pittsburgh 19, Pennsylvania.** Has 50 miles of 10-in. for *Central Hudson Gas & Electric Company* between Kingston and Albany, New York. Also has 5.7 miles of 26-in. line for *Atlantic Seaboard Corporation* in Hardy and Grant counties, West Virginia.

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FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

NEW Pipeline Equipment

• machinery • supplies • services

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

Pipe Beveling Machine Bands

Shown here are the 3 pipe beveling machine bands manufactured by Crutcher-Rolfs-Cummings, Inc. The small band at right fits 24-in. pipe. The larger two are

43¼-in. and 55⅝-in. in diameter and will go to Williams Brothers on a special pipeline job in Pennsylvania. The larger band measures more than 12-ft in circumference. — *Crutcher-Rolfs-Cummings, Inc.*

Circle number (81) on reply card.

Varec Telemetering Systems

The Vapor Recovery Systems Company has completed their study and testing program on "In Line" reading for their "Varec" pulse code liquid level and temperature telemetering systems and have announced that those who prefer this type of data viewing may now order it included in their receivers.

Data are viewed from an image optically projected directly onto ground glass located at the front of the receiver. This means that viewing is done from 1 plane and all figures are the same size and intensity. Also, the numbers are clearly visible from an oblique angle and the viewer does not have to stand directly in front of the receiver. The viewing glass is tinted for increased contrast between the figures and the background. — *The Vapor Recovery Systems Co.*

Circle number (82) on reply card.

It Clears the Land

The Rome K/G Land Clearing Blade shears trees off cleanly at ground level or below, then piles cut trees and brush compactly for burning. Only 1 tool is used to cut and windrow. It has cut trees 81 in. and up in diameter under actual field conditions, leaving the root system flush with the ground.

Large trees are felled by splitting and weakening with the sharp "stinger," then sheared off with the angled cutting edge. Stumps are sheared off at ground level or below. A wide swath of smaller trees and heavy brush is cleared at ground level in one continuous pass. — *Rome Plow Co.*

Circle number (83) on reply card.

Transport Control System

Union Switch & Signal announces the development of a pre-engineered basic centralized transport control (CTC) system containing 8 levels of security for use in pipeline applications. Union Switch & Signal engineers based the development of this standardized and packaged system on industry needs as expressed by pipeline engineers. The system was further advanced by Union engineers with years of experience in the operation of remotely controlled satellite stations.

A feature of the Basic CTC system is one that permits expansion and the addition of relays as operational needs increase. — *Union Switch & Signal Div. of Westinghouse Air Brake Co.*

Circle number (84) on reply card.

Hardened Cutting Edges

Recognizing the demands of today's faster, higher horsepowered earthmoving machines and tougher job conditions, Caterpillar Tractor has developed "Hi-Electro" hardened cutting edges. During the life of a bulldozer or scraper, cutting edges must be replaced many times. Whenever replacement occurs, either from wear or breakage, the owner must stand not only the cost of the parts, but the machine down-time and labor expenses as well.

Obstacles such as rocks and boulders give scraper cutting edges a terrific pounding during ram-pack, push loading and high speed bowl braking. Bulldozer edges encounter equally severe conditions. To meet this challenge, Caterpillar metallurgists and research engineers have produced an edge of unsurpassed performance. — *Caterpillar Tractor Co.*

Circle number (85) on reply card.

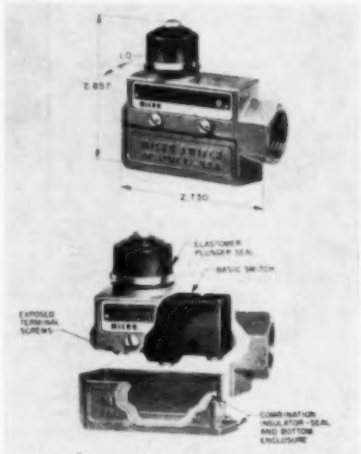
Device Gives Radio Privacy

A new automatic device, called "quiet channel," which provides operators of mobile radio systems with "isolation-booth" quiet and privacy is announced by the Radio Corporation of America. "Quiet channel" is a selective device that assures private 2-way radio communications by blocking out all unwanted messages when the channel in use is being shared with other systems. — *Radio Corporation of America.*

Circle number (86) on reply card.

Switches Compact, Easy to Wire

Micro Switch has announced a new, improved design for its widely known line of Type "E" general-purpose enclosed switches. The switches feature a compact enclosure that provides for easy installation, with a design that exposes the inside switch terminals for easy wire connection by separating the enclosure into two halves.



A second major improvement is a 1-piece molded Neoprene insulator-seal that is cemented permanently into the bottom half of the enclosure. This replaces the wrap-around insulator and separate gasket formerly used to simplify handling and improve the insulating and sealing qualities of the switch. — *Micro Switch, Div. of Minneapolis-Honeywell Regulator Co.*

Circle number (87) on reply card.

High-Powered Base Stations

Two new base station amplifiers, designed to provide up to 330-w of power and greatly increasing the signal transmitted from the dispatcher's position in a 2-way radio system, have been added to GE's line of high-powered communication equipment. The 2 latest models, for users in low and high band frequencies (25-54 and 144-174 mc), join the 250-w UHF high-power station announced by GE in December. — *General Electric Communication Products Department.*

Circle number (88) on reply card.

New Automatic Gas Sampler

The Gilbarco automatic gas sampler is designed for continuous operation in obtaining truly typical gas specimens with ease and complete weather protection of the sample and sampler components. The sampler is available in models for line pressures up to 350 psi, and special models range in capacity up to 2000 psi. Sampling time range, controlled by an explosion-proof timer, can be varied from 20 min to as little as 10 sec sampling interval. Maximum product temperature is 200 F. *Gilbert & Barker Mfg. Company.*

Circle number (89) on reply card.

NEW Literature

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

Selecting Engine Fuel

What diesel engine users should know and look for when selecting engine fuel is outlined in a 16-page illustrated booklet released by the Detroit Diesel Engine Division of General Motors. Entitled "Fuel Oil and High-R.P.M. Diesel Engines," the booklet applies to all makes of diesels which operate between 1200 and 3000 rpm.—*Detroit Diesel Engine Division.*

Circle number (90) on reply card.

Pipe Joint Wrap Folder

A new sales brochure has been prepared for the pipeline industry by L. O. F. Glass Fibers Company, featuring Duratape and Duramesh pipeline joint wraps. The folder contains descriptions of physical and chemical properties of both coal tar and asphalt-impregnated glass fiber products. Also contained are photos of typical hand wrap applications.—*L. O. F. Glass Fibers Company.*

Circle number (91) on reply card.

Piston Ring Replacement

An 8-page brochure designed to help engineers obtain maximum engine performance by careful attention to replacement of piston rings, has been published by Koppers Company. Procedures for checking pistons and cylinders are included in the brochure as well as helpful suggestions on the installation of new rings. Clearance tables for compressors and engines are also given.—*Piston Ring & Seal Department, Metal Products Division, Koppers Company, Inc.*

Circle number (92) on reply card.

Turbocharged Diesel Tractor

Major advances in design of the Allis-Chalmers HD-21 turbocharged diesel powered tractor are described in the two-color, 16-page catalog (MS-1243). Photographs and other illustrations point to these features and help tell the engineering and construction story of the tractor. Matched equipment and the line of accessories for the HD-21 are also pictured. Tractor specifications are included. — *Allis-Chalmers Manufacturing Company.*

Circle number (93) on reply card.

General Equipment Catalog

Schield Bantam Company has announced the availability of its new, revised general equipment catalog. The new, 3-color, 36-page illustrated catalog offers complete specifications and capacities for the entire Schield Bantam equipment line.—*Schield Bantam Company.*

Circle number (94) on reply card.

Tubing for Portable Pipelines

A new 8-page illustrated brochure describing mill-grooved light-weight steel tubing for use as portable pipeline with standard mechanical couplings is available. — *Steel and Tubes Division of Republic Steel Corporation.*

Circle number (95) on reply card.

GE Controls

An 88-page publication covers the complete line of control devices manufactured by General Electric's General Purpose Control Department. Selection charts covering starters through 200 hp provide quick selection of the proper starter, heater, and pushbutton station for any type of enclosure. — *General Electric.*

Circle number (96) on reply card.

Special Purpose Wood

A series of bulletins has been published describing the physical properties and uses of Greenheart (Nectanda Rodioei), a wood growing only in British Guiana, South America. This wood is suitable for such diverse oil company usages as piers, dolphins, bulkheads for terminals, warehouse and dock flooring, pipe racks, catwalks. — *Greenheart (Demerara) Inc.*

Circle number (97) on reply card.

Nordberg's Line Displayed

Nordberg's complete product line is displayed in a recently published 12-page, 3-color brochure. The handy reference booklet contains a concise description and illustration of each major type of Nordberg-built machinery. — *Nordberg Manufacturing Co.*

Circle number (98) on reply card.

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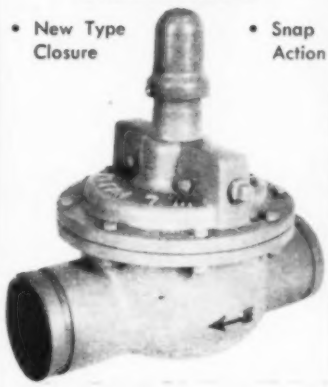

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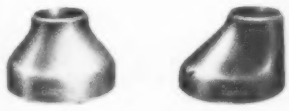

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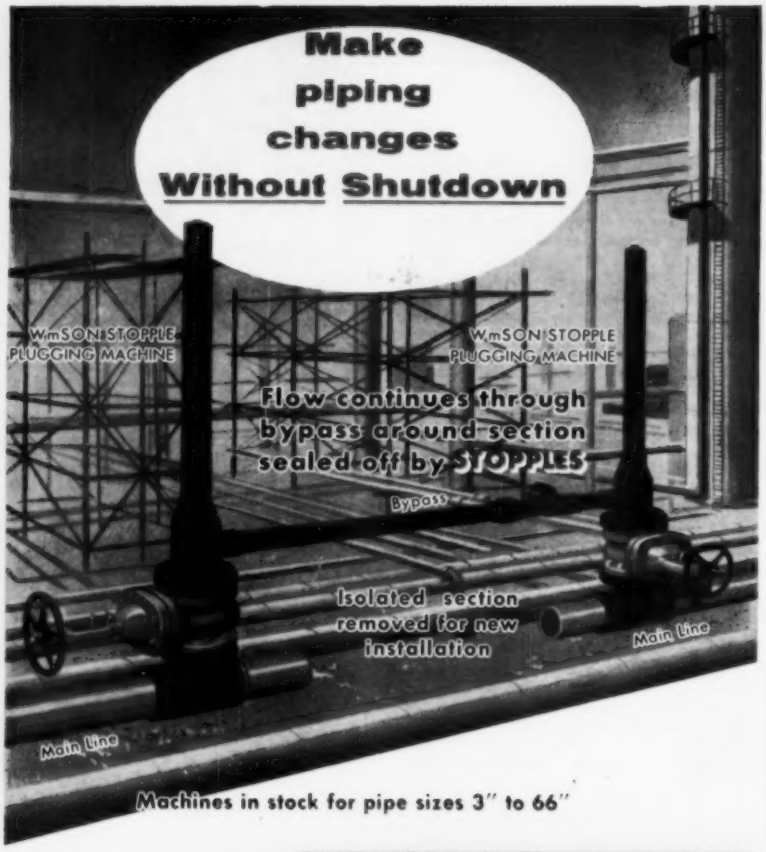
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New Literature

Pipeline Tractors

A pipeline equipment booklet titled "Spread-Speeding International Pipeline Equipment" has been released. This 16-page catalog shows the complete line of crawler tractors with sidebooms and other attachments for use in the pipeline industry. *International Harvester Company.*

Circle number (99) on reply card.

Aluminized Steel

An illustrated 6-page folder from Armco Steel tells how Aluminized Steel Type 1 resists and reflects heat and stays strong in elevated temperature service. Some of the points covered are low cost, high heat resistance, resistance to combinations of heat and corrosion, heat savings, service-proved, workability, and how supplied. — *Armco Steel Corporation.*

Circle number (100) on reply card.

Protective Coatings

A 36-page protective coatings manual features actual color chips of 102 different coating items and includes complete sections devoted to methods of surface preparation, use of primers, and finish coatings, and the availability of special custom coatings where required. — *Rust-Oleum Corp.*

Circle number (101) on reply card.

Precision Welding Fittings

Precision welding fittings and flanges, as manufactured by Tube Forgings of America, Inc., are discussed in literature just released. This company, comparatively new in the industry, claims it is making these products in a new way, and the booklet has been prepared to serve as a condensed clarification of the major points of customer and prospect inquiry. — *Tube Forgings of America.*

Circle number (102) on reply card.

Leak-Proof Valves

Incorporating detailed cross-section illustrations, a 56-page catalog provides comprehensive characteristics and data to aid in the selection and application of valves that feature the exclusive "Shear-Seal" leak-proof principle. This catalog defines in detail the complete line of "Shear-Seal" valves. – *Barksdale Valves.*

Circle number (103) on reply card.

Pipeline Diesels

Bulletin No. 116 — a brief summary of the company's line of Superior diesel, gas, and dual-fuel engines with applications in the petroleum pipeline industry — has been issued by the White Diesel Engine. The 4-page, 2-color catalog lists 19 models of 6 basic engines to meet a variety of pipeline power requirements. — *White Diesel Engine Division of The White Motor Company.*

Circle number (104) on reply card.

Tractors Job Tested

Versatility and economy of Caterpillar D7, D8, and D9 tractors is the theme of a new booklet published by Caterpillar Tractor. The 8-page publication entitled "Job Tested for Job Economy" illustrates with photos and job stories, the wide range of applications. — *Caterpillar Tractor Co.*

Circle number (105) on reply card.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

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